A Dissertation on

Comparison of N-Butylcyanoacrylate, Adhesive tapes and Sutures for Wound Closure: A Prospective Randomised Control Study

Submitted to

The Tamil Nadu Dr. M.G.R. Medical University,
Chennai – 600 032

In partial fulfillment of the regulations for the award of the Degree of

MASTER OF SURGERY (GENERAL SURGERY)

Branch I: M.S. (Gen Surg)

Department of General Surgery,

Government Stanley Medical College & Hospital,
Chennai – 600 001.

April 2013


Turnitin Document Viewer - Google Chrome
https://www.turnitin.com/dv?o=293440907&u=1014644522&s=&student_user=1&lang=en_us
TNMGRMU APRIL 2013 EXAMINA...
Medical - DUE 31-Dec-2012
What's New
Originality
GradeMark
PeerMark
Comparison of n-butylcyanoacrylate,
BY ABINAYA 22101052 M.S. GENERAL SURGERY
turnitin
19%
SIMILAR
--
OUT OF 0
1. INTRODUCTION
Suture has been used for closure of wounds for centuries and still remains the most commonly used method. The suture material has evolved from primitive and crude materials to a variety of types that are specific for the tissue to be sutured. Sutures are not without disadvantages. The needles present in sutures makes the surgeon and the assistant susceptible to needle stick injuries. The patient needs to visit the hospital again for suture removal. The use of suture leaves sutures marks perpendicular to the line of incision. These disadvantages led to the quest for alternative methods for wound closure. Few attractive alternatives that are currently available are adhesive glue and adhesive tapes. Adhesive glue has been used for traumatic wounds for over three decades since its discovery(1).Recent
PAGE: 1 OF 84
Match Overview
1 Publication 5%
2 www.ethicon.com Internet source 1%
3 en.wikipedia.org Internet source 1%
4 Amin, M.. "Randomized Publication 1%
5 www.ofv.sa.gov.au Internet source 1%
6 www.ncbi.nlm.nih.gov Internet source 1%
Text-Only Report
17:57
11-12-2012

INSTITUTIONAL ETHICAL COMMITTEE, STANLEY MEDICAL COLLEGE, CHENNAI-1

Title of the Work	: Randomised control study of n-butyl cynoacrylate, Adhesive tapes and sutures for wound closure: A Prospective randomized control study
Principal Investigator	: Dr.R.C.Abinaya
Designation	: PG in M.S (GS)
Department	: Department of General Surgery Government Stanley Medical College, Chennai-1

The request for an approval from the Institutional Ethical Committee (IEC) was considered on the IEC meeting held on 06.03.2012 at the Council Hall, Stanley Medical College, Chennai-1 at 2PM

The members of the Committee, the secretary and the Chairman are pleased to approve the proposed work mentioned above, submitted by the principal investigator.

The Principal investigator and their team are directed to adhere to the guidelines given below:

1. You should inform the IEC in case of changes in study procedure, site investigator investigation or guide or any other changes.
2. You should not deviate from the area of the work for which you applied for ethical clearance.
3. You should inform the IEC immediately, in case of any adverse events or serious adverse reaction.
4. You should abide to the rules and regulation of the institution(s).
5. You should complete the work within the specified period and if any extension of time is required, you should apply for permission again and do the work.
6. You should submit the summary of the work to the ethical committee on completion of the work.

12/10/12

MEMBER SECRETARY,
IEC, SMC, CHENNAI

CERTIFICATE

This is to certify that **Dr. ABINAYA R.C**, postgraduate student (May 2010 – April 2013) in the department of General Surgery, Stanley medical college, Chennai, has completed his dissertation titled "**Comparison of N-Butylcyanoacrylate, Adhesive tapes and Sutures for Wound Closure: A Prospective Randomised Control Study"** under the direct guidance and supervision in partial fulfillment of the regulations laid down by the TamilnaduDr.M.G.R. Medical University, Chennai for M.S., Branch – I General surgery degree examination

Prof.Dr.T.S.Jayashree, M.S
AssoProf and Unit Chief,
Department of General Surgery,
Govt. Stanley Medical College,

Prof.Dr. P. Darwin, M.S
Prof & Head of Department,
Department of General Surgery,
Govt. Stanley Medical College,

Prof. Dr. S. GEETHALAKSHMIM.D,Phd
Dean
Govt. Stanley Medical College,
Chennai – 600001

DECLARATION

I, **Dr. ABINAYA R.C**, solemnly declare that the dissertation titled "**Comparison of N-Butylcyanoacrylate, Adhesive tapes and Sutures for Wound Closure: A Prospective Randomised Control Study"**is a bonafide work done by me at Govt. Stanley Medical College and Hospital under the guidance and supervision of my unit chief,

Prof. Dr.T.S.**Jayashree, M.S**

AssoProfessor of General Surgery

This dissertation is submitted to the Tamilnadu Dr. M.G.R. MEDICAL UNIVERSITY towards the partial fulfillment of the requirements for M.S., Branch I General Surgery degree examination.

Place: Chennai – 600001

Date: Dr. ABINAYA. R.C

ACKNOWLEDGEMENTS

.I sincerely thank**Prof. Dr. S. Geethalakshmi, M.D., PhD**, The Dean, Govt. Stanley Medical College & Hospital and **Prof. Dr. P. Darwin, M.S.**, the Professor & Head of Department of General Surgery, Govt Stanley Medical College & Hospital,for permitting me to carry out this study, and also to the Institutional Ethical Committee for having approved this proposal.

I owemy gratitude to **Prof. Dr.T.S.Jayashree, M.S.,** the AssoProfessor &Unit chief, Department of General Surgery, Govt Stanley Medical College & Hospital, for coordinating my project work and guiding me throughout to pursue and accomplish the task.

I owe my gratitude to **Prof. Dr.G.Muthukumaran, Asso**Professor of Surgeryand **Prof. Dr.Srinivasalu,** Professor of Pediatric Surgery for guiding me throughout the study.

I am indebted to my Assistant Professors: **Dr.D.Dorai, MS.,D.or**thoand**Dr.**T.**Chitra, MS, DGO**who helped me in every step and for encouraging me. I acknowledge my other colleagues too for their kind cooperation and their contributions.

My heartfelt thanks to my patients for unconditionally and freely consenting to be a part of this trial aimed to achieve better post-surgical outcomes.

CONTENTS

INTRODUCTION

1. INTRODUCTION

Suture has been used for closure of wounds for centuries and still remains the most commonly used method. The suture material has evolved from primitive and crude materials to a variety of types that are specific for the tissue to be sutured. Sutures are not without disadvantages. The needles present in sutures makes the surgeon and the assistant susceptible to needle stick injuries. The patient needs to visit the hospital again for suture removal. The use of suture leaves sutures marks perpendicular to the line of incision. These disadvantages led to the quest for alternative methods for wound closure. Few attractive alternatives that are currently available are adhesive glue and adhesive tapes. Adhesive glue has been used for traumatic woundsfor over three decades since its discovery(1).Recent focus is on the usage of adhesive glue for surgical incisions. There are only a few clinical trials that have been conducted to support this indication (2).Another method is the application of adhesive tape for wound closure. The tape is available very cheap as compared to glue and suture and has shown to be a fast and cheap alternative in a study done previously(3). There are very few studies that have compared the three methods for wound closure.

The study was conducted to compare the use of sutures, adhesive glue and adhesive tape for closure of surgical incision wound.

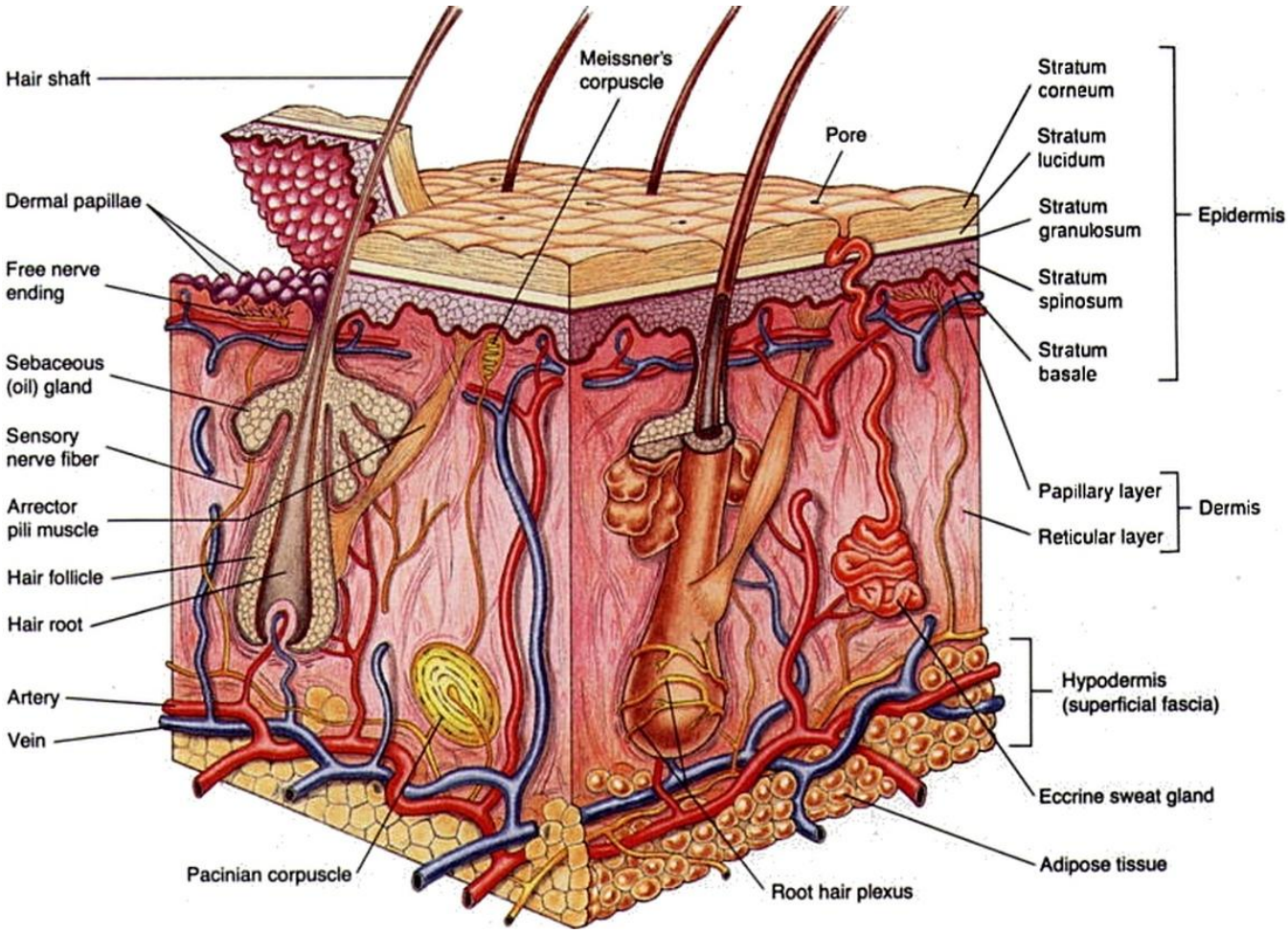
REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

2.1. ANATOMY OF SKIN:

The skin is made up of three layers (4)

- The epidermis which is the outermost layer
- The dermis
- The subcutaneous tissue.



Epidermis:

The epidermis is lesser than one millimeter in thickness and contains three types of cells, the keratinocytes which constitute most of the epidermis. They are produced in the epidermal base. It is rich in moisture and as they migrate towards the skin surface from the epidermal base they lose the moisture and become hardened and ultimately die. These dead keratinocytes along with the sebum secreted from the surface form the stratum corneum. They are continuously sloughed off and replaced. The other cells are the melanocytes that produce the pigment melanin. Melanin is responsible for the skin color. The other cells are the Langerhans cells. They are a part of the immune system and protect against pathogens in the epidermis.

Dermis

Immediately below the epidermis is the layer called dermis. It is the most thickest of the three and they contain fibroblasts. They contain abundant collagen and elastin proteins that make the skin elastic and resilient. It also contains tiny capillaries and lymphatics of the skin. It has the sebaceous glands that produce sebum. This protective substance reaches the epidermis via tiny hair follicles. This sebum lubricates and protects the

surface of the skin.(5) The dermis has a superficial and deep plexus and they are interconnected via communicating vessels.

Subcutaneous Tissue:

The subcutaneous tissue is the innermost layer of the skin and contains adipocyte fat cells. It provides insulation to the body and serves as padding. The sweat glands are present in this layer. The hair follicles are connected to a system of smooth muscles called the errectorpilli.

Appendages of the skin:

The skin contains various appendages they are

The sweat glands

The sweat glands are widely distributed across the skin surface and helps in maintaining the temperature of the body. There are two types of sweat glands the eccrine glands that open via a duct onto the skin surface and apocrine glands that empty into the hair follicles.

The sebaceous glands

The sweat glands produce a substance called sebum that is oily in nature. It serves as a lubricant which helps in keeping the skin moist and also prevents brittle hair. The acidic medium of the sebum also prevents

bacterial colonization. Most of the ducts of the sebaceous glands open into the hair follicle.

Hair follicles – they are made up of hard keratinized epithelial cells

2.2. WOUND

Type	Definition (6)
Clean	Wounds that are not due to trauma wounds which have no break in technique Wounds where respiratory, alimentary, or genitourinary tract was not entered
Clean contaminated	wounds where the respiratory or the gastro intestinal tract was entered but without significant spillage Wounds where Oropharynx, vagina, or noninfected genitourinary or biliary tract entered wounds which have minor break in technique
Contaminated	wounds with major break in technique Wounds due to trauma wounds with Gross spillage from gastrointestinal tract wounds after entrance into genitourinary or biliary tracts in presence of infected urine or bile

Dirty	Presence of pus or perforation or wounds after incision through an abscess

2.3. WOUND HEALING

Wound healing involves a complex mechanism which is also dynamic since it is influenced by the wound environment and changing health condition of the individual. (7) The process of wound healing begins as soon as the injury occurs and can go on for months to years. A lot of research has been made and is undergoing to understand the mechanism of wound healing. The different types of cells that appear in the wound at different durations of healing are known. There are also a number of growth factors and proteins that play a role in wound healing.

An incision given by the surgical knife, any trauma due to accident or tissue injury due to myocardial infarction, all undergo similar process of repair.

There are three types of wound healing (8)

- Primary
- Secondary

- Tertiary

The process of primary healing occurs within hours after its creation, repair of a full thickness surgical incision. The cut edges are well defined and approximation is accurate. This results in minimal inflammation and minimal wound contraction.

There is no formal closure of the wound in secondary wound healing. The wound is spontaneously closed by contraction and re-epithelialization. The inflammatory response is more intense in secondary healing when compared to the primary healing. This results in greater amount of granulation tissue which results in greater degree of wound contraction.

Tertiary wound healing is also known as delayed primary closure. The wound is initially debrided for a period of time and later closed, once healthy granulation tissue has formed. Tertiary wound closure is done in contaminated wounds following trauma or any other external injury.

The process of wound healing can be divided into four stages

1.Stage of Hemostasis

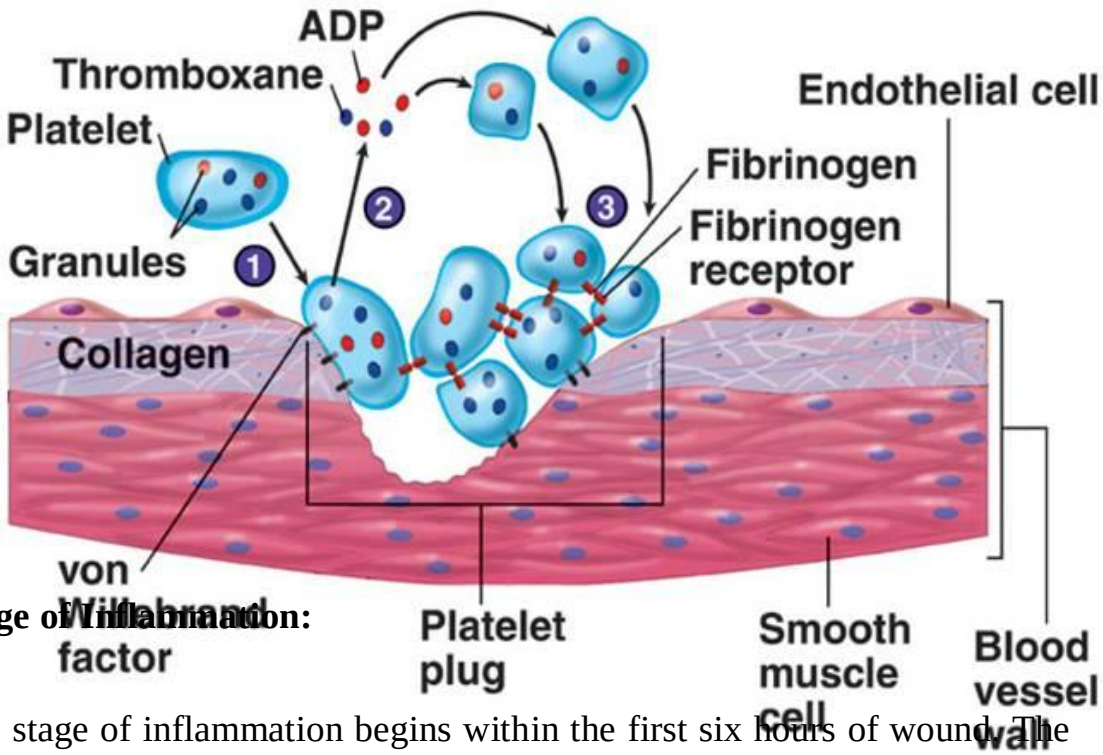
2.Stage of Inflammation,

3. Stage of granulationformation, and

4. Stage of Tissue remodeling

Stage of Hemostasis:

The stage of hemostasis involves a cascade of growth factors and cells that interact in a coordinated and directed manner that results in wound closure. The first step is vasoconstriction followed by coagulation where the clotted blood gets immediately impregnated in the wound resulting in hemostasis. After vasoconstriction, the initial injury results in recruitment of inflammatory cells in the wound. There is adherence of platelets to the injured and damaged endothelium of blood vessels and release of adenosine diphosphate (ADP). This results in platelet clumping. Initiation of inflammatory is due to release of various cytokines by the thrombocytes. Alpha granules release platelet derived growth factor (PDGF), and transforming growth factor beta (TGF-b). Dense bodies are found in thrombocytes which release histamine and other vasoactive amines like serotonin. PDGF act as a chemotactic factor for fibroblasts and in combination with TGF-b, it is a potent modulator of the fibroblast mitosis. This results in increased collagen deposition in later phases. Once fibrinogen is cleaved to form fibrin the framework for coagulation process is completed. The structural support for the cellular components of inflammation is provided by the fibrin.



Stage of Inflammation:

The stage of inflammation begins within the first six hours of wound. The wound is infiltrated with polymorphonuclear leukocytes (PMNs). Migration of PMN is facilitated by TNF-b which help in their movement from the injured blood vessels. These cells serve as cleansers of the wound removing the debris. The PMNs reach maximum concentration in 24 to 48 hours and after 72 hours the number start to reduce. Other factors like fibro blast growth factor (FGF) , PDGF, Transforming growth factors alpha and beta (TGF-a and TGF-b) and compliments C3a and C5a are also released.Monocytes exude from the damaged vessels and they are transformed into macrophages. The cleaning process is continued by the macrophages and further debris is cleared from the wound site. It also secretes a number of growth factors during the 3rd or 4th day. They help in endothelial cell multiplication and new blood vessels begin to sprout. They

also help in multiplication of smooth muscle cells. The macrophages also secrete a number of other factors like cytokines and interleukins IL1, Tumor necrosis factor and PDGF. The migration of epithelial cells begins to occur in the first 12 to 24 hours and new tissue is formed over the next ten days.

Granulation Stage:

The stage of granulation has different sub phases. These sub phases overlap with each other. They are

- Fibroplasia
- Deposition of matrix
- New blood vessel formation or angiogenesis
- Re-epithelization

Fibroplasia

By five days the fibroblasts have reached the wound by migration and begin laying down new collagen type I and type III. Type III collagen

predominate the early stages of wound healing. It is replaced by type I collagen in later stages.

Deposition of matrix

Tropocollagen is the precursor form of collagen and it undergoes transformation in the rough endoplasmic reticulum of the fibroblast where hydroxylation of proline and lysine occurs. Establishment of disulphide bonds make three tropocollagen to join together to create a left handed triple helix structure called procollagen. This procollagen is secreted out of the cell and the peptidases present in the cell wall cause cleavage of terminal peptide chains resulting in formation of true collagen fibrils. The various glycosaminoglycan deposited in the wound are heparansulphate, hyaluronic acid, chondroitin sulphate and keratin sulphate.

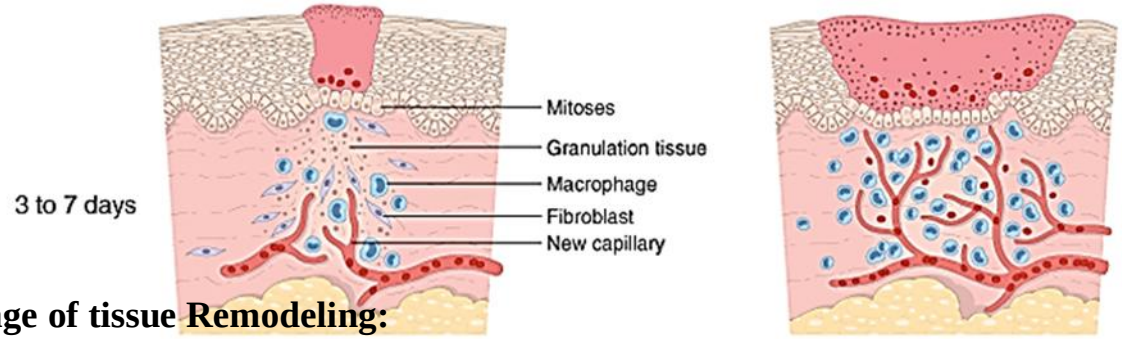
Angiogenesis

New blood vessels are formed from the offshoot that arises from the parent vessels. For angiogenesis to occur the basement membrane and extracellular matrix has to be degraded. This is followed by migration, multiplication and maturation of the endothelial cells. FGF and vascular endothelial growth factor involve in modulation of this process.

Re-epithelization

The migration of cells from the wound edges and adnexa results in reepithelization of the wound. The process starts within 24 hours of injury. Division and multiplication of the peripheral cells start by 48 hours and a thin layer of epithelial layer is formed. This helps to bridge the wound. This is majorly influenced by the epidermal growth factor.

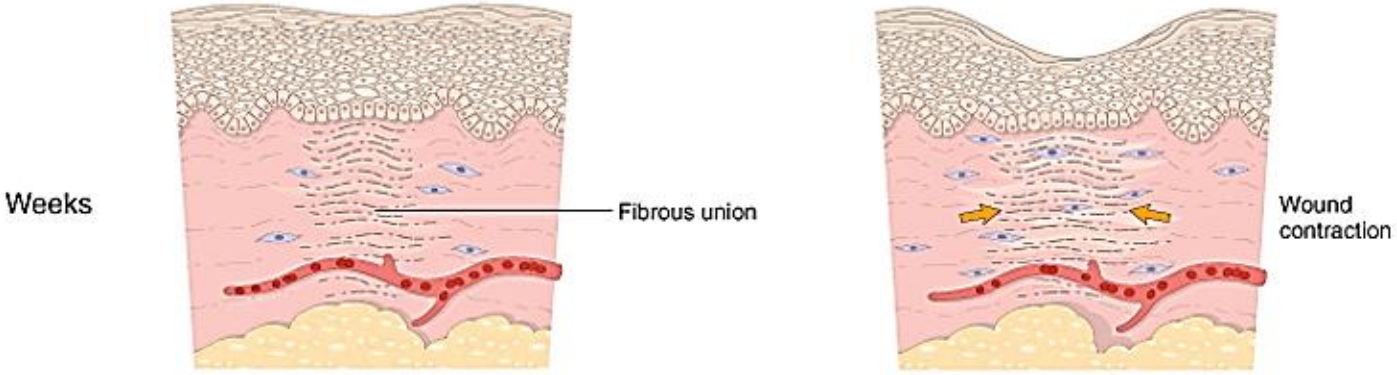
The newly formed extracellular matrix along with the blood vessels, constitute the granulation tissue.



Stage of tissue Remodeling:

The final stage is the remodeling. In this stage there is wound contraction and the tensile strength of the wound is achieved. It takes about six to twelve months. The wound undergoes constant modifications and alterations after the third week and go for years after the initial injury. The collagen is in equilibrium where the degradation and deposition go hand in hand thereby maintaining the amount of collagen in the wound constant. The amount of collagen deposited in the normal wound healing is at its peak at third week after the wound. Proliferation of special fibroblasts called myofibroblasts help in wound contraction. They are similar to the

contractile smooth muscle cells. There is greater degree of wound contraction in secondary healing when compared to the primary healing.



Factors Affecting Wound Healing

The following are the factors that affect wound healing

Infections

Infection is one of the most important factor that affects wound healing. Wound infection occurs due to lack of sterile techniques during surgery, improper wound care postoperatively, handling of wound without washing the hands, contamination from external sources. Once wound infection is suspected proper antibiotic coverage following culture and sensitivity is necessary along with adequate management of the wound.

Advanced Age

Aging leads to a significant delay of epithelialization of superficial skin defects. This is due decreased accumulation of collagenous protein at the site of wound in advanced age

Hypoxia, Anemia and Hypoperfusion

Oxygen is an essential component of wound healing. Lack of oxygen results to tissue hypoxia and it has a negative impact on all stages of wound healing. Oxygen serves as a cofactor in the synthesis of collagen.

Steroids and Chemotherapeutic Drugs

Administration of steroid reduces the synthesis of collagen and reduced the wound strength. It also inhibit the inflammatory stage of wound healing. There is decreased leukocyte migration to the wound site. There is reduced epithelialization and contraction.

Metabolic Disorders

Patients with metabolic disorders like Diabetes mellitus and Uremia have reduced wound healing. These conditions result in reduced inflammatory response, angiogenesis and collagen synthesis.

Nutrition

Adequate nutrition is essential for wound healing. In patients with Protein energy malnutrition there is decreased hydroxyprolineaccumulation and this leads to impaired fibroplasia. Patients with vitamin C deficiency have impaired collagen synthesis and cross-linking.Many essential minerals have important role in wound healing. Zinc is essential for fibroblast proliferation, epithelialization, synthesis of collagen and ultimately the wound strength.

Radiation

Radiation causes decreased inflammatory response and reduced cell migration.

Pressure

Excessive pressure over the wound site leads to disruption of the capillary network. This impedes the amount of blood flow to the surrounding tissues and wound healing is delayed.

Vascular insufficiency

Patients with vascular insufficiency have reduced blood supply to the wound area. This results in chronic wounds that fail to heal even on proper medical management.

Susceptibility to Hypertrophic Scars and Keloids

Patients who are prone to hypertrophic scar and keloids have excessive wound healing response. Even minimal damage can elicit a severe response by the body that results excessive inflammation and collagen deposition. These scar are often ugly and are difficult to treat since recurrence is common after excision. Administration of steroid at the scar site can reduce the risk for keloid formation.

Trauma

Repeated trauma to the wound site can delay the wound healing process significantly.

2.4. SURGICAL PRINCIPLES OF WOUND CLOSURE

2.4.1 SUTURES

2.4.1.1. WHAT IS A SUTURE? (9)

Suture is a thin strand of material that is used to tie or approximate the body tissues like blood vessels, skin etc. They can also be used to close the wounds. The use of suture dates back to 2000 BC where it was used by the Syrians and Egyptians for treating wounded people. Newer materials were

introduced like cotton, linen, tendons, gut and wires from metals for the operative procedures. Some are being used until now. The suture has evolved today in a manner that has resulted in creating specific material for specific procedure. Though the type of material has changed, the principle of wound closure and knottingstill remains the same. A needle in still needed to penetrate the tissue and advance to the desired site.

Usage of right suture material for the right tissue in the operation helps in proper wound healing and prevents any complications during recovery.

2.4.1.2. PERSONAL SUTURE PREFERENCE

Studies show that most surgeons follow a set “suture routine”. They tend to use the same suture until any specific need arises for a different one. Repeated use of the same suture makes the surgeon confident and comfortable with it and may prefer to use it his career.

The factors that affect the choice of suture are

- Area of specialty
- Experience gained during surgical training
- Knowledge on wound healing
- Knowledge about the various types of materials
- The profile of the patient

Proper understanding of the physical properties of the suture and its application in biological systems like body tissues is necessary to ensure adequate wound healing and recovery. The surgeon must be up to date with changing trends and newer technologies and must be willing to accommodate it into his clinical practice.

2.4.1.3. SUTURE CHARACTERISTICS

Various factors influence the choice of the suture. They are, the number of layers involved , the level of tension in the surgical site, the depth involved in the suture placement, amount of tissue edema and time required for suture removal.

The characteristics of an ideal suture are

- The tensile strength must be very high for its size
- The strength should be uniform
- It must have uniform diameter.
- The suture should remain secured during the duration of healing and then rapidly absorbed
- It should be simple to handle
- It must be packed in a secure manner which is sterile

- It must have a long storage life
- The strength should remain same until it is being used
- The knot must stay secured after application
- Absence of irritating materials and impure substances
- It should be inert and not induce any reaction in the body
- The performance must be constant and predictable

2.4.1.4. SIZE AND TENSILE STRENGTH

Size of the suture is given by the diameter of the suture material. Accepted surgical technique is the usage of the smallest size of suture that will adequately hold the healing wound together. This will help minimizing the trauma that the suture does to the tissue when it is passed through for closure. This will also reduce the amount of foreign body entering the body and thus help in reduction of tissue inflammation and reaction.

Suture size is denoted by number of 0s . The more the number of 0s thinner or smaller is the diameter. For example size 3-0, or 000, is smaller than 2-0 or 00, in diameter. Size is directly proportional to tensile strength. Larger the size, larger is the tensile strength. Another important that is to be considered is the tensile strength of the knot in a suture. It is the force that the suture can withstand before breakage when being knotted. The tensile strength of the tissue that is to be sutured is to be known

beforehand. It should never exceed the tensile strength of the suture that is to be used.

2.4.1.5. MONOFILAMENT VS. MULTIFILAMENT STRANDS

Classification of the suture is based on the number of strands in each suture. Monofilament suture contains only one strand of material. Since the structure is simple they encounter minimum resistance when they pass through the tissue. They also prevent harboring of organisms that may cause wound infection These factors make monofilament suture better suited for vascular anastomosis. They can be tied easily. However, crushing of the suture during handling can result in a weak spot in the strand, resulting in breakage of the suture.

Multifilament sutures contain a number of filaments, or strands that aretwistedor braided together. This results in higher tensile strength, increased pliabilityandflexibility. They can also be coated aiding in smooth passage through the tissues like intestinal tissues.

2.4.1.6. ABSORBABLE VS.NONABSORBABLE SUTURES

Sutures are also classified based on the degradation properties. Absorbable sutures undergo rapid degradation in body tissue and lose their tensile strength within sixty days. Those sutures that can retain the strength even

after sixty days are called non absorbable sutures. Absorbable sutures are used in those situations where the wound is to be approximated temporarily until it has healed sufficiently and is able to withstand normal stress. They are manufactured from collagen of mammals or can be synthetic polymers. Some are absorbedrapidly and some withstand absorption for longer time due to chemical treatment. They are also colored with dye to improve visibility in tissue. Natural absorbable sutures undergo digestion in the body by enzymes that attack and break the suture strands. Synthetic sutures undergo a process of hydrolysis by which water penetrates the strands slowly and causes breakdown of the polymer chain. Hydrolysis by water reduces the degree of tissue reaction when compared to the natural materials.

The suture is absorbed in two stages. In the first stage, the tensile strength reduces gradually in a linear manner. This occurs during the first several weeks after application. The second stage overlaps with the later weeks of first stage and characterized by loss of suture mass. The suture material is gradually removed by the leukocytic infiltration at the suture site. The loss of suture strength and the rate at which it is absorbed are two different phenomena. A suture can lose its strength fast but can be absorbed slowly. Or it can maintain the strength for a long duration until wound healing and later be absorbed rapidly without any detectable trace.

The limitations of absorbable sutures are :

Presence of infection or protein deficiency may accelerate the rate of absorption resulting in loss of tensile strength

If the sutures become wet before application, the absorption can begin prematurely

Similarly, patients with impaired wound healing have poor outcomes with this suture. Thus use of absorbable suture in such situations result in higher postoperative complications since the suture strand can't withstand stress until wound healing is adequately completed.

The sutures that are not digested by body enzymes and that do not undergo hydrolysis in the body are called nonabsorbable sutures. They are manufactures using non biodegradable substances. The fibroblasts encapsulate the suture ultimately or are walled off. Usage of non-absorbable suture for skin closure requires removal postoperatively.

Nonabsorbablesutures have a number of uses:

Closure of skin incisions following surgery or wounds following trauma exteriorly

Inside the body they are permanently encapsulated

In patients who have a history of allergy to absorbable suture and susceptible individuals to keloid or hypertrophic scars.

Patients requiring prosthesis placement like pacemakers etc

The multiple filaments in the suture are of equal diameter and according to the United States Pharmacopeia(U.S.P.) limitations for each size.They have been classified according to their composition by the USP.

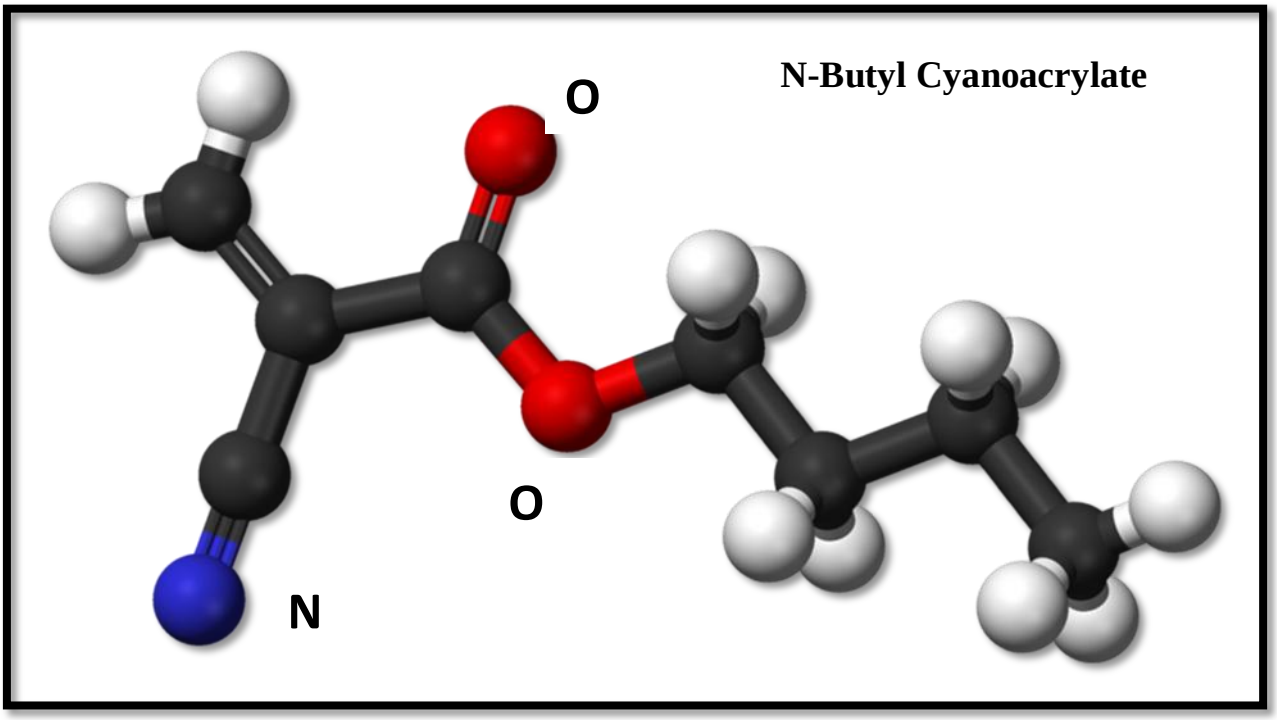
2.4.2 ADHESIVE GLUE

Cyanoacrylates are used commercially as fast acting glue with significant bonding capacity. It was first synthesized by Airdis in 1949. The application of cyanoacrylates as an adhesive and its use in surgery was described by Coover et al (10). The cyanoacrylates was used extensively in the Vietnam was by the US troops and it helped to save many lives. It later got FDA approval for management of wounds.

Cyanoacrylates is manufactured by reacting alkyl cyanoacetate and formaldehyde that produces a prepolymer. This prepolymer can be heated into a liquid monomer. The monomer can be modified by changing the alkoxycarbonyl (-COOR) group to produce compounds of varied side chain lengths. When applied living tissues the monomer undergoes a exothermic hydroxylation which results in polymerization of the glue. Studies showed that shorter chain derivatives have higher levels of tissue toxicity than the longer chain compounds.

N-Butyl Cyanoacrylate

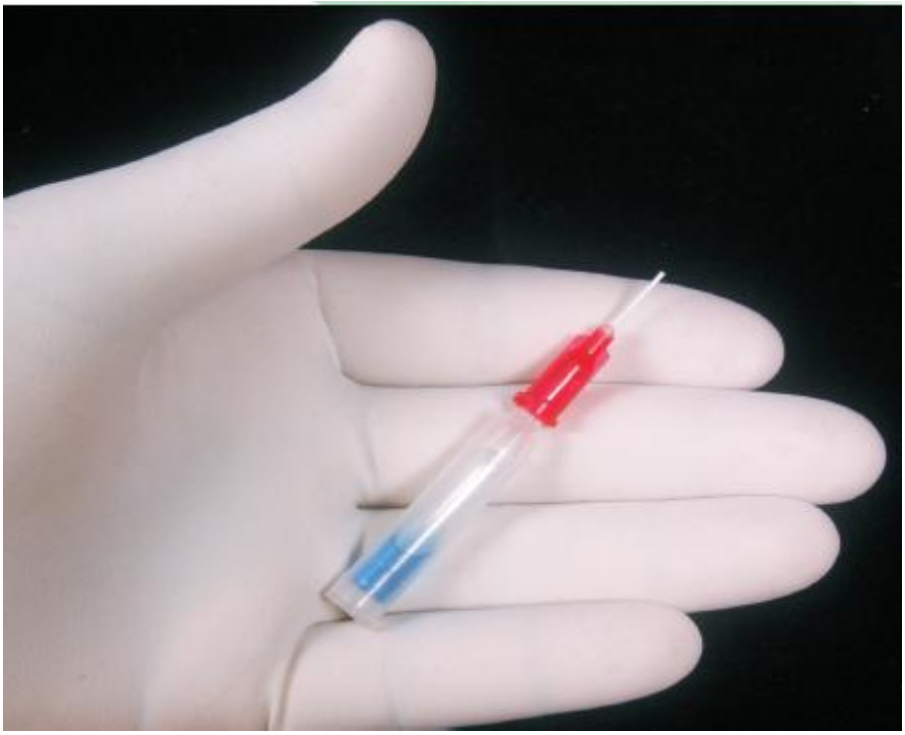
It is a cyanoacrylate ester which is a butyl ester of 2-cyano-2-propenoic acid. It is a clear and colorless liquid which has a sharp and irritating odor. It is insoluble in water.



This compound is mainly used as a component of the medical adhesive glues. Isobutyl cyanoacrylate and octyl cyanoacrylate are other compounds that are used in the medical field. They are bacteriostatic and their application is mostlypainless. The bond Butyl esters are strong but are also rigid.It is soluble in substances like acetone, nitromethane, and methylene chloride. The monomers polymerize very rapidly when there is presence of

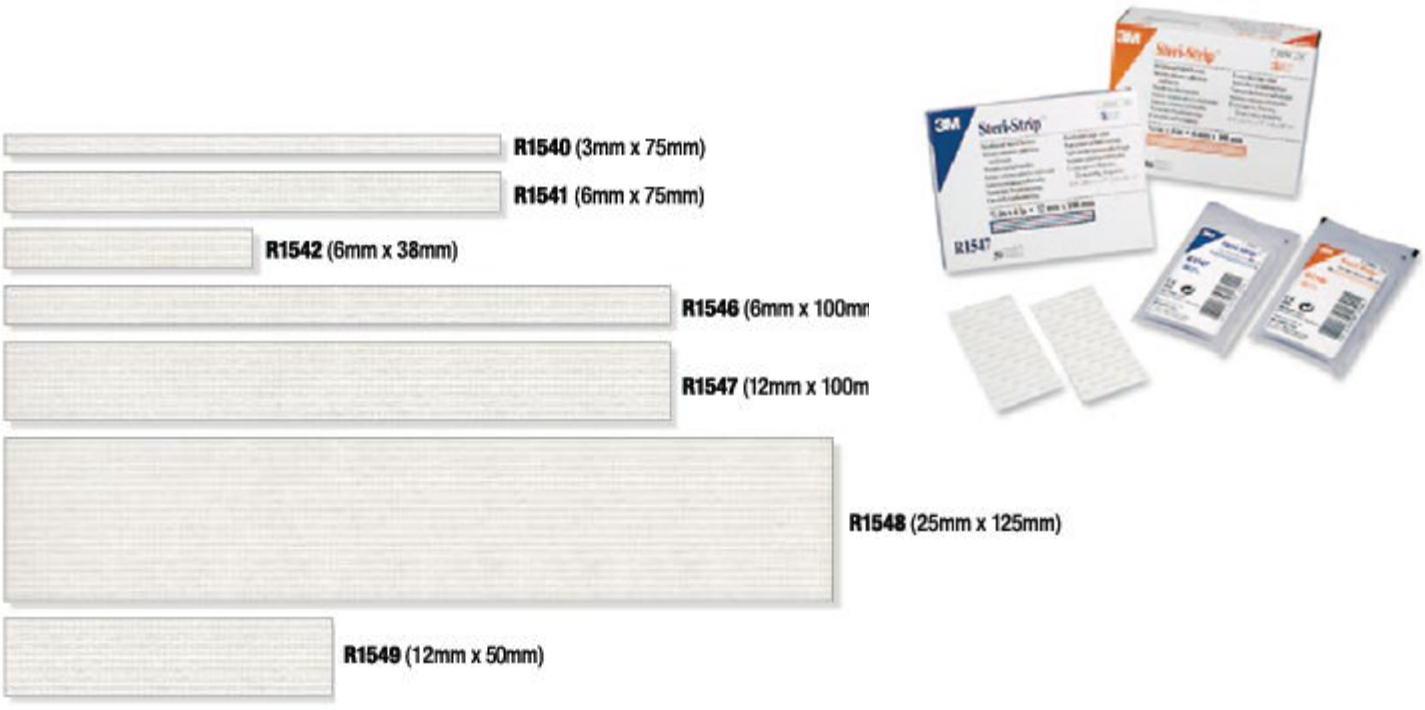
moisture, blood or tissue fluid. The unique properties of butyl cyanoacrylate when compared to the others are

- The tensile strength is high and optimum for closure of surgical incisions
- It has inherent bacteriostatic property
- The application of adhesive glue is quick
- It can also be used for embolization of cerebral Arteriovenous malformations(11)
- It is degraded by the body thus help in creation of nano drugs with sustained release profiles
- They are also indicated in treatment of esophageal, duodenal, gastric and colonic varices. by endoscopy (12.13).



2.4.3 ADHESIVE TAPES

The adhesive tapes or strips were used for surgical wound closure since the 1500. I was first described by Pare in France. He utilized strips of sticky plaster for closure of facial wounds after trauma. This made the edges of the wound to be joined and splinted. Significant research has been done since then. They have evolved today into porous paper tapes that ensure proper apposition of the wound edges. They also give additional reinforcements after application of suture or adhesive glue. Often use of tincture of Benzoin help in tape adherence.



AIMS AND OBJECTIVES

3.AIMS AND OBJECTIVES

The objectives of the present study are

1. To compare the wound dehiscence rates of suture, N-Butyl-2-Cyanoacrylateglue and adhesivetape following wound closure
2. To compare the wound infection rates of the three closure methods
3. To compare the time taken for wound closure using the three techniques
4. To compare the costs incurred for wound closure in three methods
5. To compare the cosmetic appearance of the three wound closure methods
6. To compare the patient satisfaction in the three closure techniques
7. To compare the surgeon satisfaction in the three closure techniques

MATERIALS AND METHODS

4. MATERIALS AND METHODS

4.1. Setting: Department of General Surgery,
Government Stanley Hospital, Chennai

4.2. Study design: Prospective Randomised Controlled Study

4.3. Ethical Clearance: Obtained

4.4. Informed Consent: Obtained

4.4. Study period: 1 year

4.5. Materials: **Inclusion Criteria**: Patients undergoing elective hernia surgery were randomized into three groups and the skin incision following surgery was closed using either suture, adhesive glue or adhesive tape.

Exclusion criteria: Patients with Diabetes Mellitus, Tuberculosis, Steroids intake, Connective tissue disorders, Past history of Keloid/ Hypertrophic scar, Drug allergies, known allergy to cyanoacrylate or formaldehyde were excluded from the study.

Randomization chart – Suture - 1, Glue - 2, Tape - 3

Research Randomizer Results

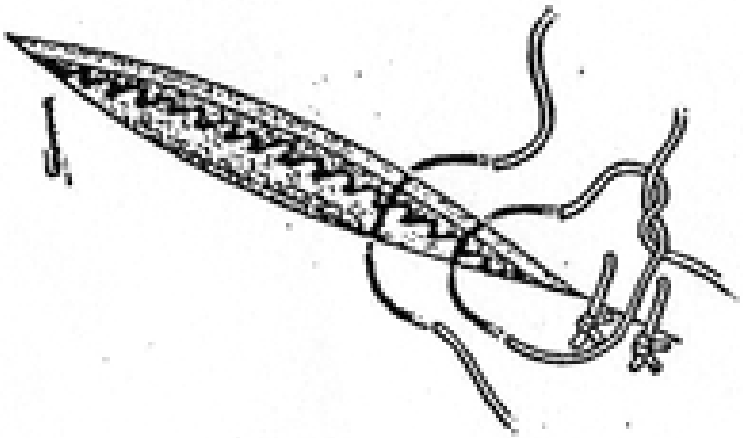
p1=1, p2=2, p3=3 p4=2, p5=3, p6=1 p7=2, p8=3, p9=1 p10=1, p11=2, p12=3
p13=3, p14=2, p15=1 p16=1, p17=3, p18=2 p19=3, p20=1, p21=2
p22=1, p23=2, p24=3 p25=2, p26=1, p27=3 p28=1, p29=3, p30=2
p31=1, p32=3, p33=2 p34=2, p35=3, p36=1 p37=2, p38=1, p39=3
p40=2, p41=1, p42=3 p43=1, p44=2, p45=3 p46=2, p47=3, p48=1
p49=1, p50=2, p51=3 p52=1, p53=3, p54=2 p55=2, p56=1, p57=3
p58=3, p59=2, p60=1

The method of closure according to the randomization chart was noted for each patient and sixty tokens were made. To avoid selection bias, the patient was asked to choose one of the token and was applied accordingly. In patients with bilateral hernia, they were asked to select two tokens, one for each side.

4.6. METHODOLOGY

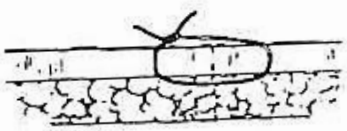
4.6.1. SUTURE APPLICATION:

3-0 Monofilament Polypropylene (PROLENE* polypropylene suture) was used for suturing the skin wounds. Simple interrupted sutures were used for closure.

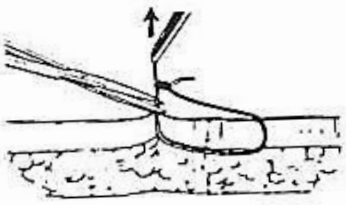


Suture Removal

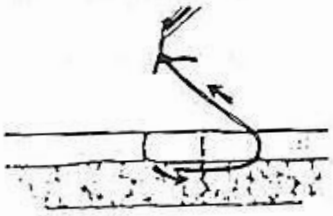
The suture was removed on the seventh postoperative day using sterile precautions.



STEP 1. NOTE THAT THE SUTURE KNOT IS LOCATED TO ONE SIDE OF THE INCISION LINE. THE SUTURE IS CUT BELOW THIS KNOT ON THE SAME SIDE.



STEP 2. GRASP ONE END OF THE SUTURE WITH THE FORCEPS AND PULL UP. MAINTAIN GENTLE TRACTION UPWARD TO EXPOSE A SMALL PORTION OF THE SUTURE THAT HAS BEEN JUST BELOW THE SKIN SURFACE. CUT THE SUTURE BELOW THE PORTION ORIGINALLY EXPOSED AT THE SURFACE. PLACE THE ROUNDED TIP OF THE SCISSORS NEXT TO THE SKIN SUFACE. (SUTURE SCISSORS HAVE ONE ROUNED AND ONE SHARP TIP.)



STEP 3. PULL THE CUT SUTURE UP AND OUT OF THE SKIN.

4.6.2. N-BUTYL-2-CYANOACRYLATE APPLICATION:

1. The device is held between forefinger and thumb. Firm pressure is applied on the middle of cylindrical plastic jacket to crush the glass ampule inside. The adhesive is released into the plastic jacket.

Hold the device
between two fingers

2. The device is turned upside down and moved near the site of application. By applying firm pressure using the fingers, microdrops of adhesive are delivered on to the closely approximated skin edges.

Firmly press in the
middle to crush the
glass ampule inside

3. The tip of the device is not allowed to get in contact with the skin, tissue or open wound during the whole procedure.

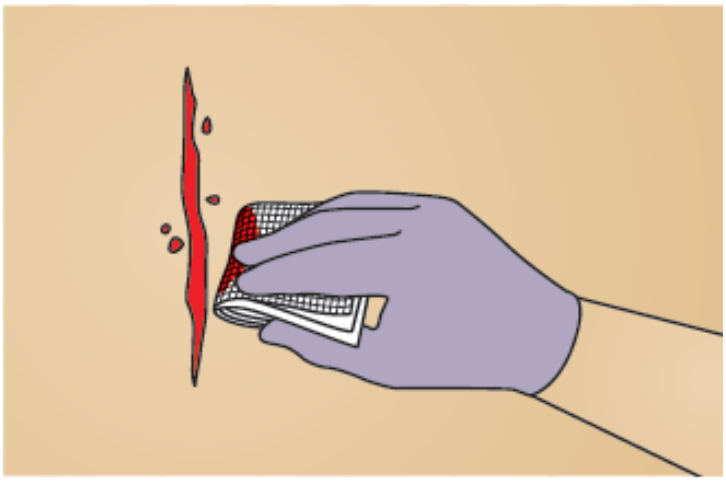
Adhesive is released into the plastic jacket

4. Wait for 30 to 60 seconds for the polymerization and bonding to complete.

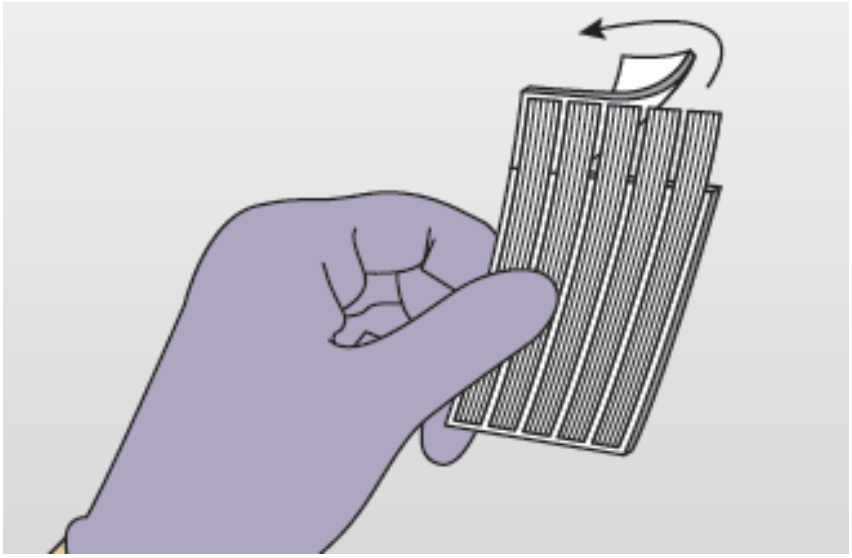
Invert the device and hold between two fingers. Firmly press to release the adhesive as micro drops

4.6.3. STERISTRIP ADHESIVE TAPE APPLICATION:

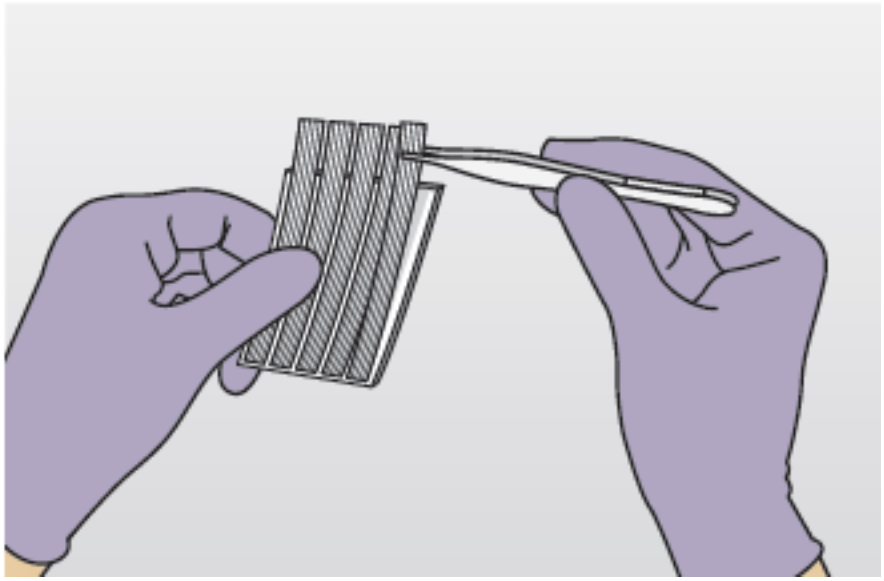
1. The skin has to be clean and dry for a minimum of two inchesaround the wound. Benzoin tincture can be used if enhanced strip adhesion is needed



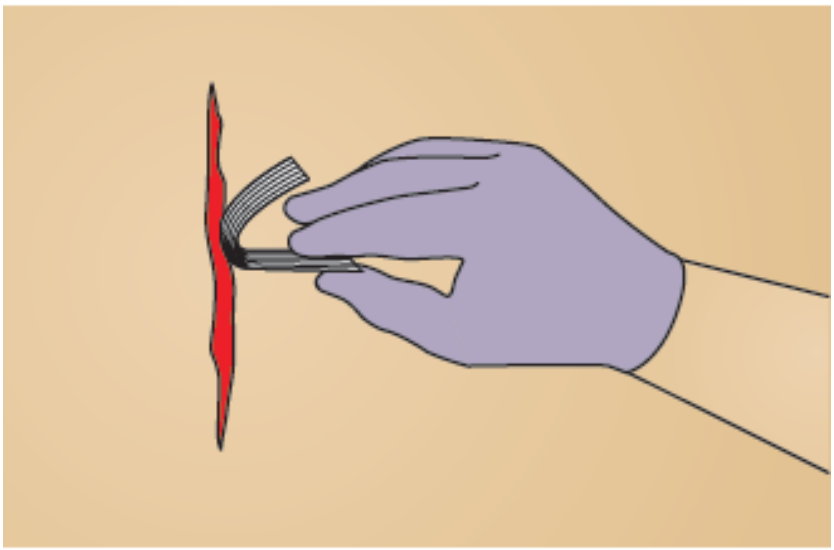
2. The back package tabs are peeled to access the adhesive tapes. The card is removed under sterile precautions and one end is bent to remove the tapes



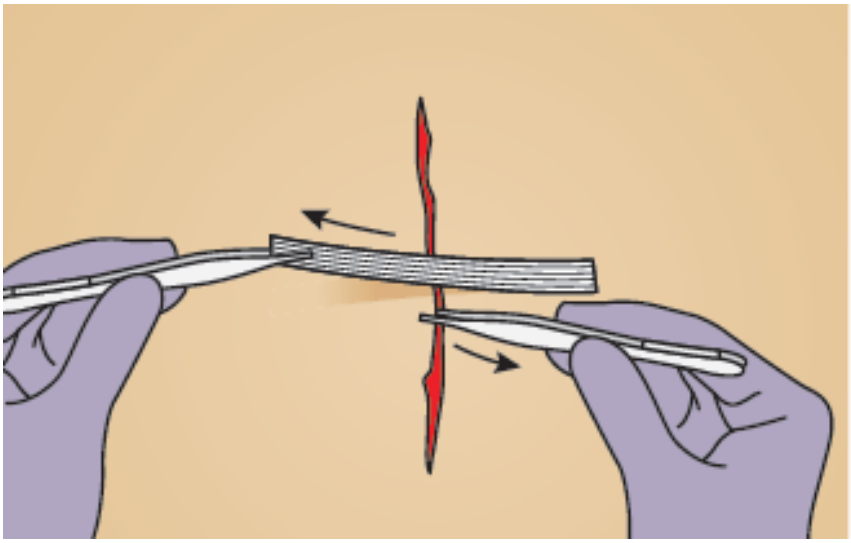
3. The end of the strip is held with forceps or gloved hands and lifted upwards at 90 degree angle. Inadequate lifting may result in the tape to become curled complicating handling.



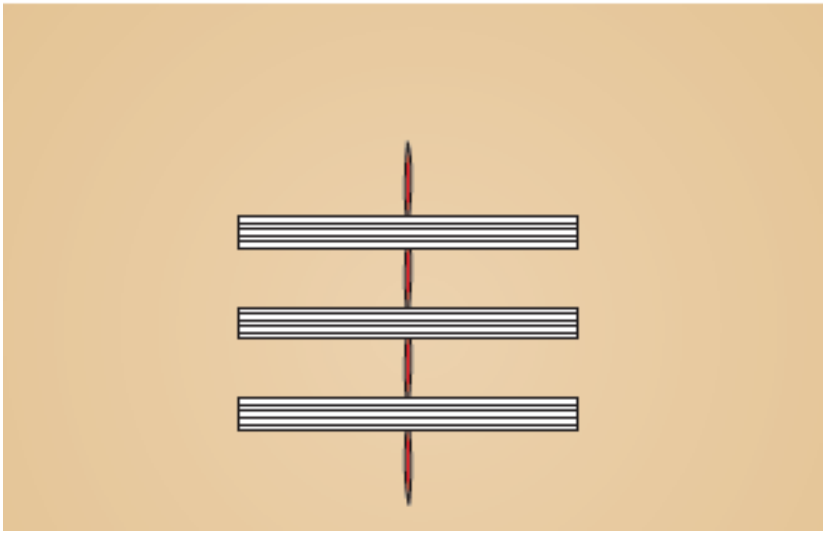
4 The closure is started at the middle of the wound and the tape should be applied without tension. The strip should not be stretched One half of the strip is applied to the wound margin on one side and pressed firmly in place.



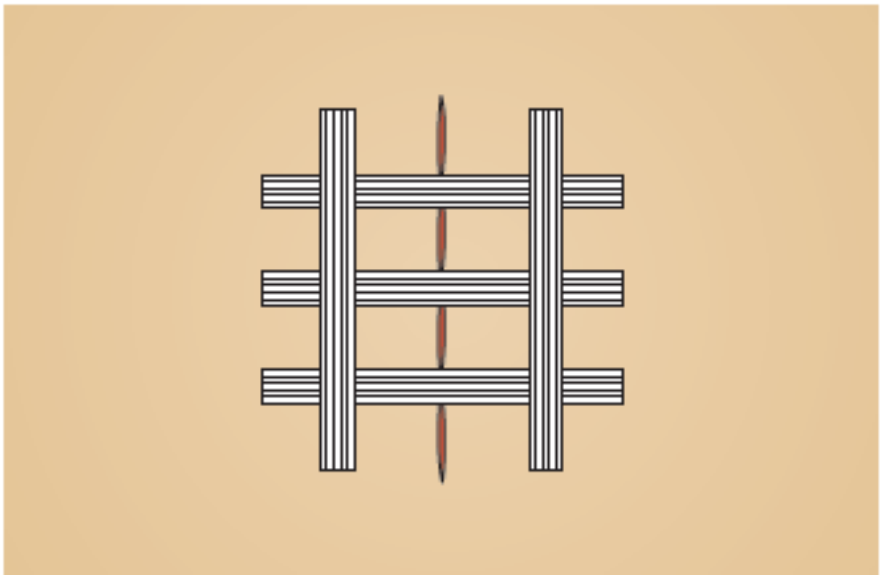
5.The finger or forceps the skin edges is apposed as closely as possible. The other half of the tape is applied firmly on the other side of the wound.



6.Further strips are applied in the wound with approximately 1/8space apart until the edges are approximated completely. If the edges are not properly apposed the strip is removed and reapplied.



7. Additional tapes can be applied parallel to the wound with a distance of ½ inch from the ends in a rail road fashion. This helps to diminish the stress beneath the ends of and decrease the risk for tension blisters.



STERISTRIP REMOVAL:

1. The cross stays are removed first. The ends on the strip are loosened

2 The skin is stabilized with one finger and the strip is removed slowly towards the wound. The strip should be kept close to the skin surface and pulled back over itself.

3 The above step is repeated in the other end of the strip and once the strips are loosened, it is removed by lifting the strip from the center of the wound.

4.7. TYPES OF OUTCOME MEASURES

4.7.1. WOUND DEHISCENCE

Wound dehiscence was identified by presence of any gap, tear or break in the surgical wound following closure. The wound was examined for dehiscence on day 1, 2. 3, 7, 30 and 90.

4.7.2. WOUND INFECTION

Infection was considered present if any of the following were observed (14):

Redness, swelling, purulent discharge, pain, increased skin temperature, fever or other systemic signs of infection. The wound was examined for infection on day 1, 2. 3, 7, 30 and 90.

4.7.3. EFFICIENCY

The efficiency of wound closure method was assessed by measuring the total time taken for closure. A digital stop watch was used for the measurement. The clock was started after preparing the skin for closure following closure of abdominal wall layers. The clock was stopped once

the closure was completed and the total time taken was noted in minutes and seconds.

4.7.4. COST

The cost of closure technique was assessed by noting the number of suture, glue or tape utilized for each patient. The total cost was calculated after multiplying the cost of each with the number used in the patient. Any additional cost incurred following any complicationsif occurred, was also noted for each patient.

The cost of the closure methods are

3-0 Polypropylene monofilament suture – Rs 180 per piece (Ethicon, USA)

Adhesive Glue –Rs 540 per 0.5 ml vial ((XOIN, India)

Adhesive Tape –Rs 60 per packet (Steristrip, 3M, USA)

4.7.5. COSMETIC APPEARANCE

The cosmetic appearance was assessed by using the pre validated Hollander wound evaluation score and Visual analogue scale. They were assessed on the day 1, 2. 3, 7, 30 and 90.

4.7.5.1. Hollander wound evaluation score (15)

The Hollander wound evaluation score was calculated using the presence or absence of the following factors,

1 **Step off borders -**Edges not on the same plane

2 **Contour irregularities -** Wrinkled skin near the wound

3 **Wound margin separation >2mm** - Gap between the sides

4 **Excessive distortion -** Swelling or infection

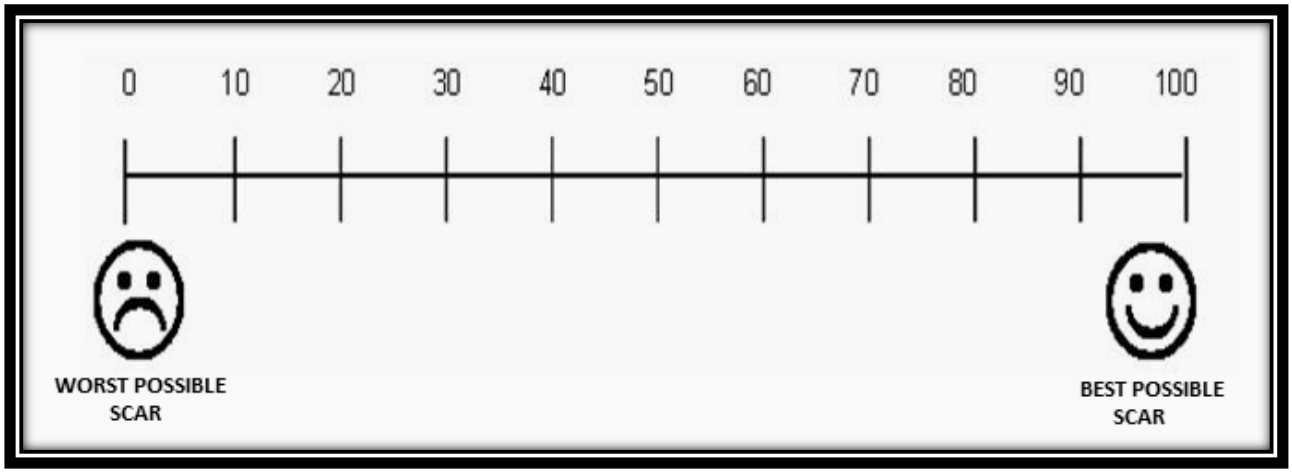
5 **Edge inversion** - Wound Not properly everted

6 **Overall cosmetic evaluation-** Acceptable not Acceptable

Each of the above categories is graded on a 0 or l-point scale. A total cosmetic score is derived by addition of the scores of the six categorical variables. A score of 6 is considered optimal, while a score of 5 is considered suboptimal (16)

.7.5.2. The Visual Analogue Score(17)

The Visual Analogue Score was calculated using a scale ranging from 0 to 100 with 0 being the worst possible scar and 100 being the best possible scar



4.7.6. PATIENT SATISFACTION

The patient satisfaction was assessed using a pre validated questionnaire (18) on the day 7, 30 and 90.

Cosmesis of wound	**Poor** **Satisfactory** **Excellent** **0 1 2 3 4 5 6 7 8 9 10**		
Ability to shower the same day	**Poor (0)**	**Satisfactory(1)**	**Excellent (2)**
Tension on wounds	**Significant(0)**	**Moderate (1)**	**Slight (2)**
Overall comfort	**Poor (0)**	**Satisfactory(1)**	**Excellent (2)**
Hygiene problems	**Yes(0)**	**No(1)**	
Allergic reactions	**Yes(0)**	**No(1)**	
Overall satisfaction	**Poor** **Satisfactory** **Excellent** **0 1 2 3 4 5 6 7 8 9 10**		

The total score for each patient was noted.

4.7.7. SURGEON SATISFACTION

The patient satisfaction was assessed using a pre validated questionnaire (18) on the day 7, 30 and 90.

Cosmesis of wound	**Poor**	**Satisfactory**	**Excellent**
	0 1 2 3 4 5 6 7 8 9 10		
Ease of use	**Poor (0)**	**Satisfactory(1)**	**Excellent (2)**
Safety	**Poor (0)**	**Satisfactory(1)**	**Excellent (2)**
Effectiveness	**Poor (0)**	**Satisfactory(1)**	**Excellent (2)**
Applicability to a wide range of incisions	**No(0)**	**Yes(1)**	
Allergic reactions	**Yes(0)**	**No(1)**	
Overall satisfaction	**Poor**	**Satisfactory**	**Excellent**
	0 1 2 3 4 5 6 7 8 9 10		

The total score for each patient was noted.

4.8. STSTISTICAL ANALYSIS

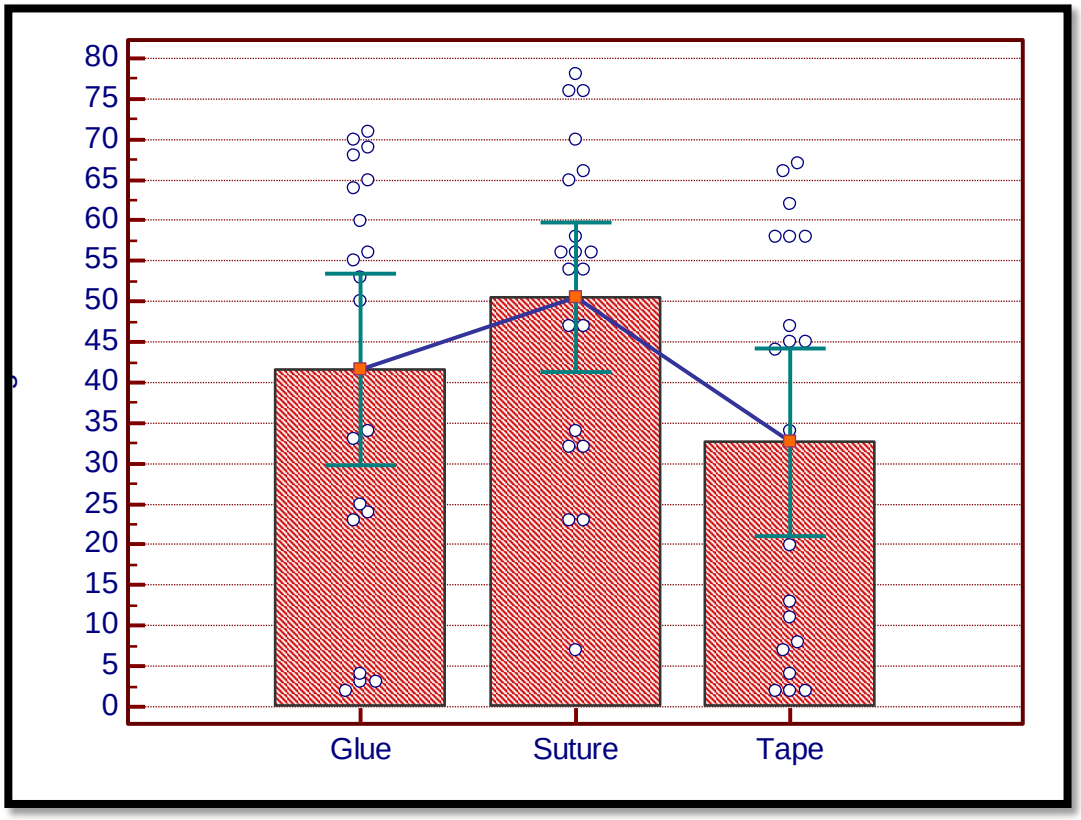
All data was entered in a master chart and statistical analysis was performed using Medcalc Software Version 2,3Mariakerke, Belgium. The demographics were analyzed using ANOVA. The test for significance for time, length was done using non parametric Kruskal–Wallis test. The Hollander scar evaluation score was analyzed using the Fishers Exact test for significance. The visual analogue scale, the patient and surgeon satisfaction score were analyzed using Kruskal–Wallis test and Mann Whitney test. A P value < 0.05 was considered as significant.

RESULTS AND ANALYSIS

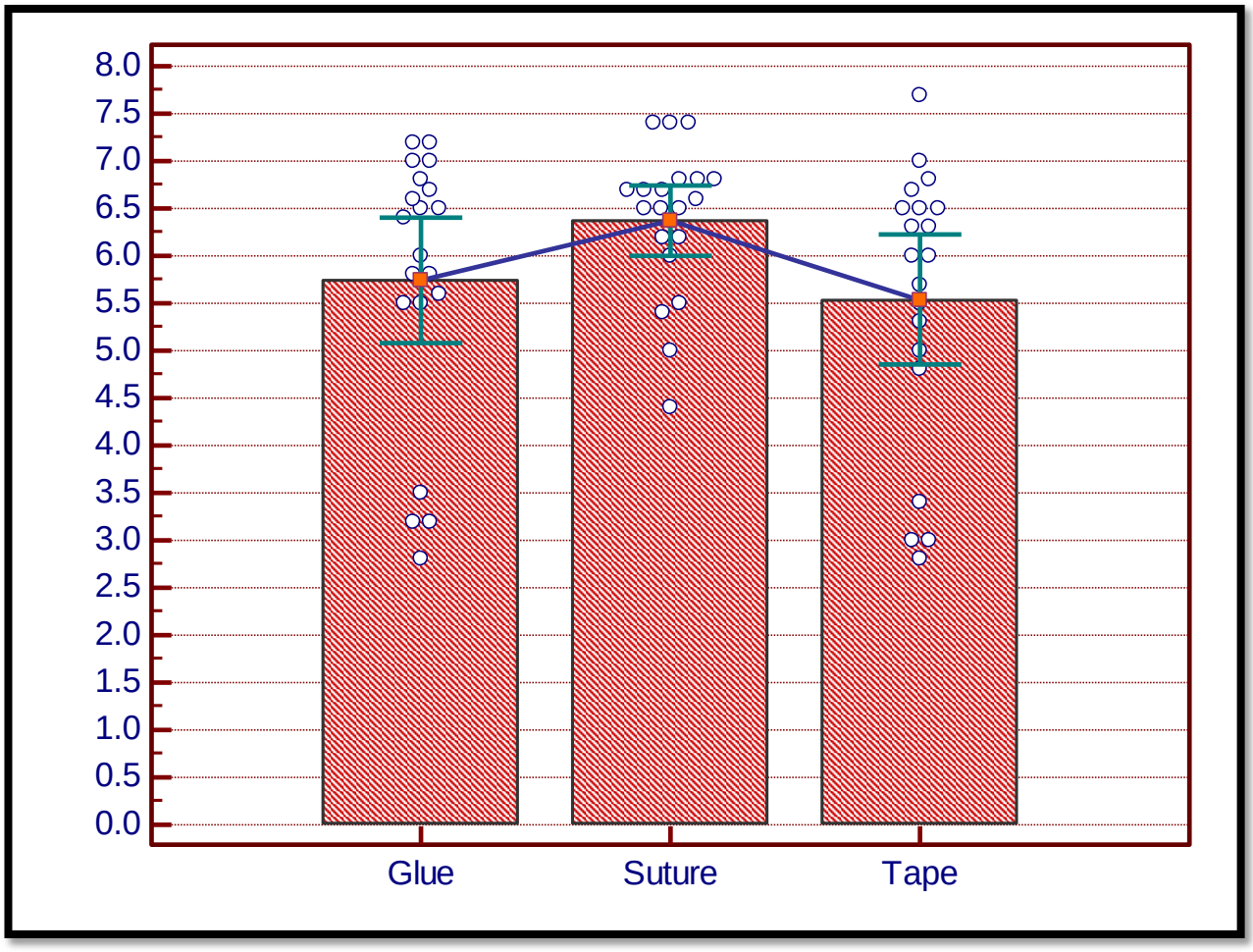
5.RESULTS

5.1 DEMOGRAPHICS

A total of 60 patients were randomized into three groups of 20 each. Among the 60 participants 55 were males and 5 were females. The mean age of patients in suture, glue and tape group was 50.5, 41.6 and 32.65 years respectively. There was no significant difference in the age among three groups (P = 0.0939)



The mean length of wound incision in suture, glue and tape group was 6.37, 5.74, and 5.54 respectively. There was no significant difference in the incision length among three groups (P = 0.1232) making the three groups comparable for the different wound closure methods.



5.2 OUTCOME MEASURES

5.2.1. WOUND DEHISCENCE

Wound dehiscence was noted in one patient in the glue group during the second post-operative day. The wound was closed by using 3-0 polypropylene suture using sterile precautions.

5.2.2. WOUND INFECTION

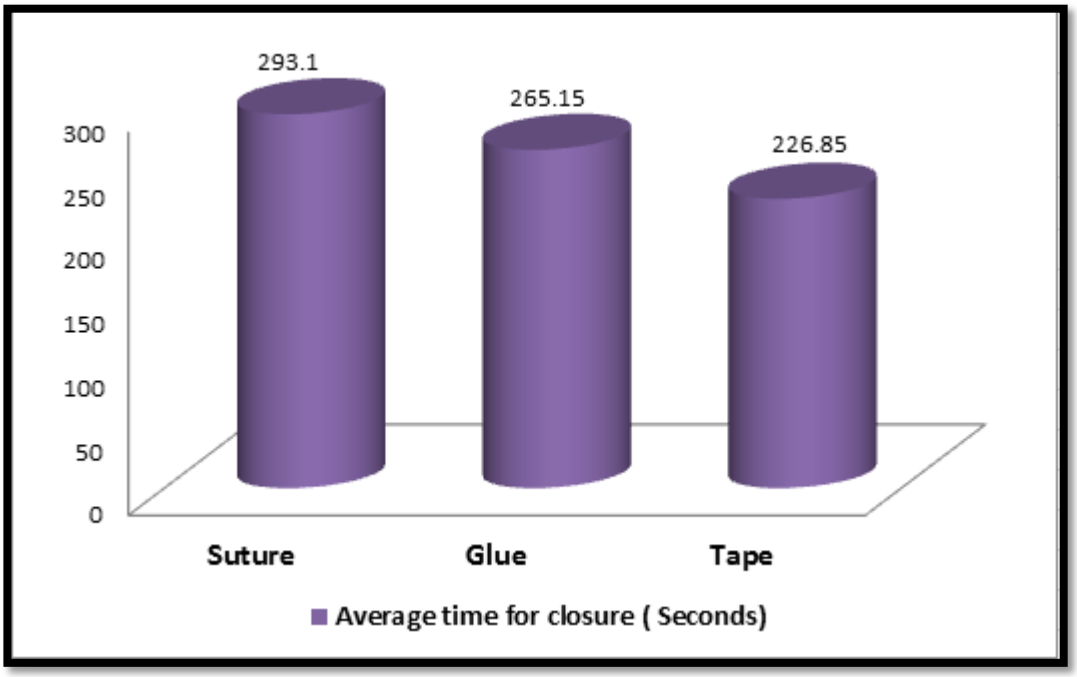
There was no wound that got infected during the study period.

5.2.3. EFFICIENCY

Time

The average time taken for closure was 293.1 seconds for suture method, 265.15 seconds for the adhesive glue and 226.85 seconds for the adhesive tape. The application of adhesive tape took significantly less time when compare to the suture and glue method ($P = 0.0067$). There was no significant difference in the time taken for application of suture and glue.

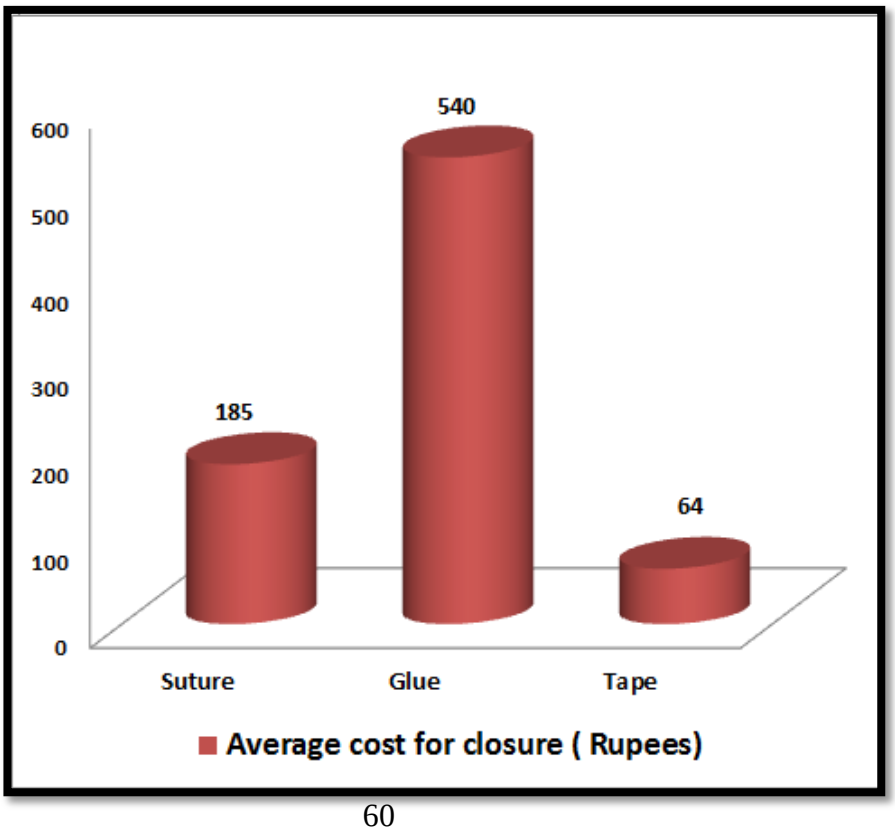
	Average time for closure
Suture	**293.1**
Glue	**265.15**
Tape	**226.85**
P = 0.0067 Tape vs Suture, Glue	



5.2.4. COST

The average cost of closure using Suture was Rs. 185, adhesive glue - Rs. 540 and adhesive tape – Rs 64. There is a significant difference in the cost involved for wound closure among the three groups (P<0.001).

	Average cost for closure (Rupees)
Suture	**185**
Glue	**540**
Tape	**64**
P < 0.001 Tape vs Suture vs Glue	



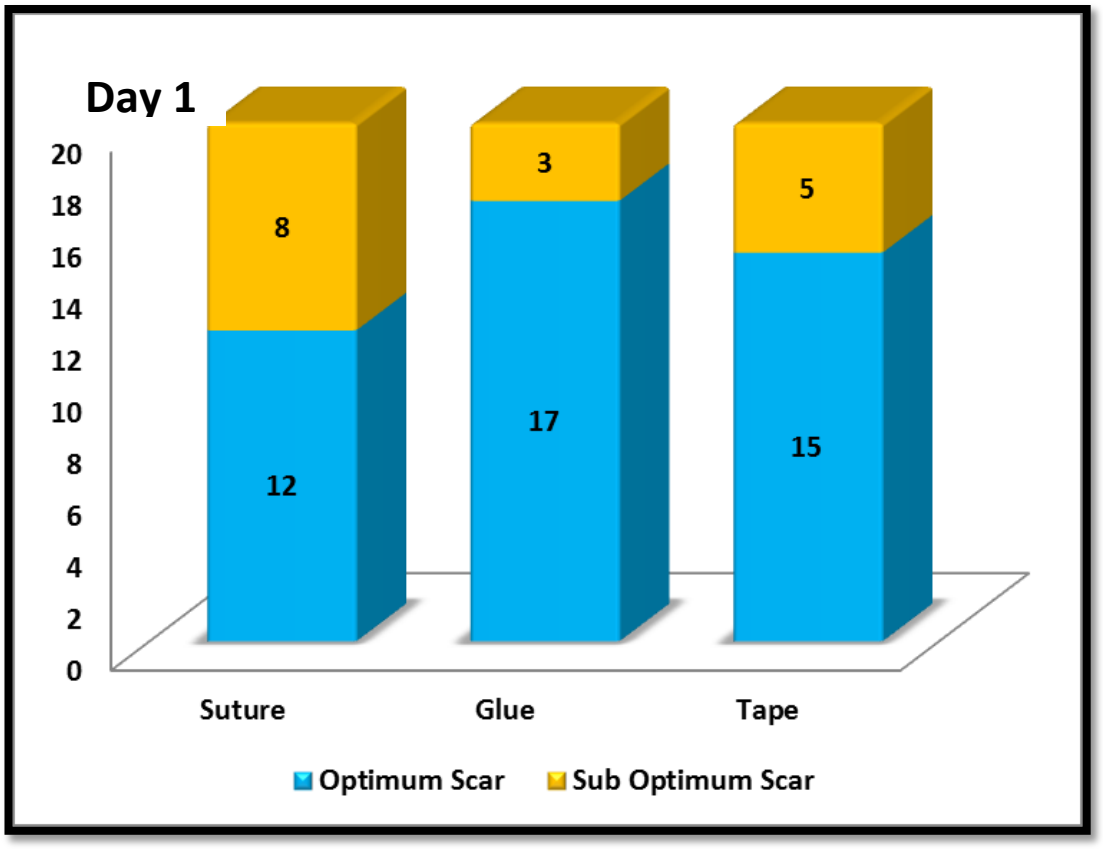
5.2.5. COSMETIC APPEARANCE

5.2.5.1. Hollander wound evaluation score

Day 1

There was no significant difference in the Hollander wound evaluation score among the three groups on day 1.

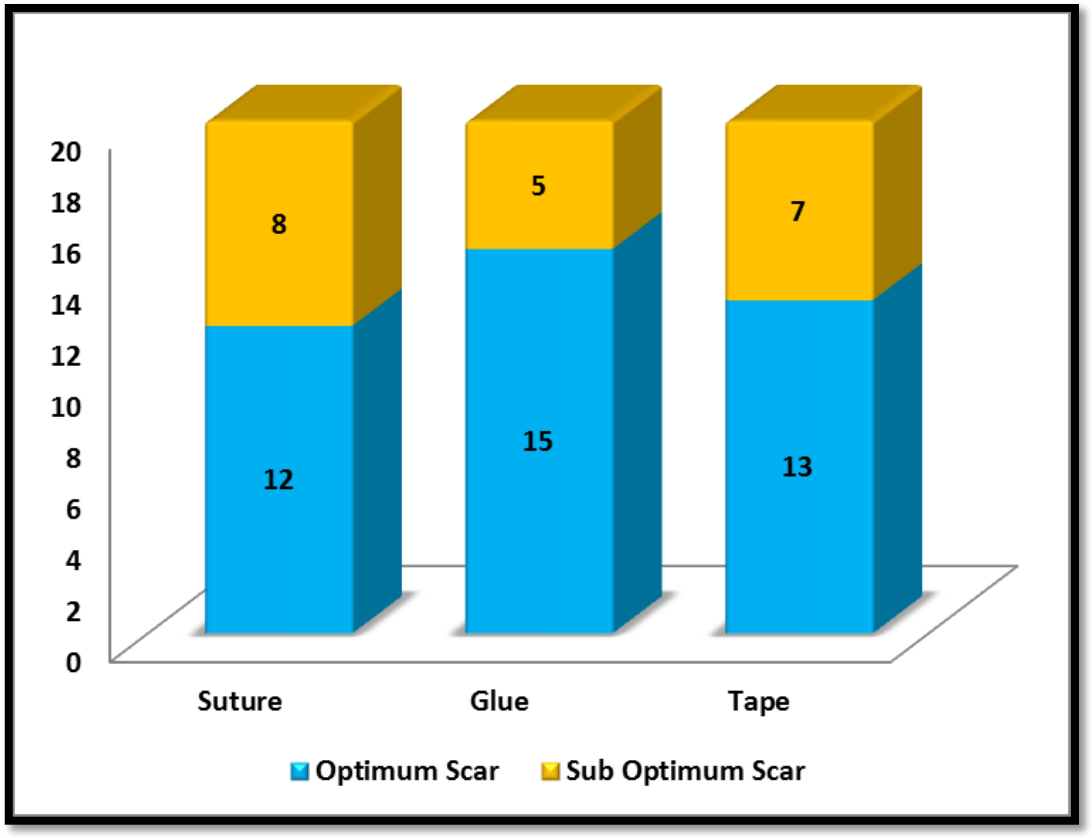
	Optimum Scar	Sub Optimum Scar	Suture	Glue
Suture	**12**	**8**		
Glue	**17**	**3**	**P = 0.1551**	
Tape	**15**	**5**	**P = 0.5006**	**P = 0.6947**



Day 2

There was no significant difference in the Hollander wound evaluation score among the three groups on day 2.

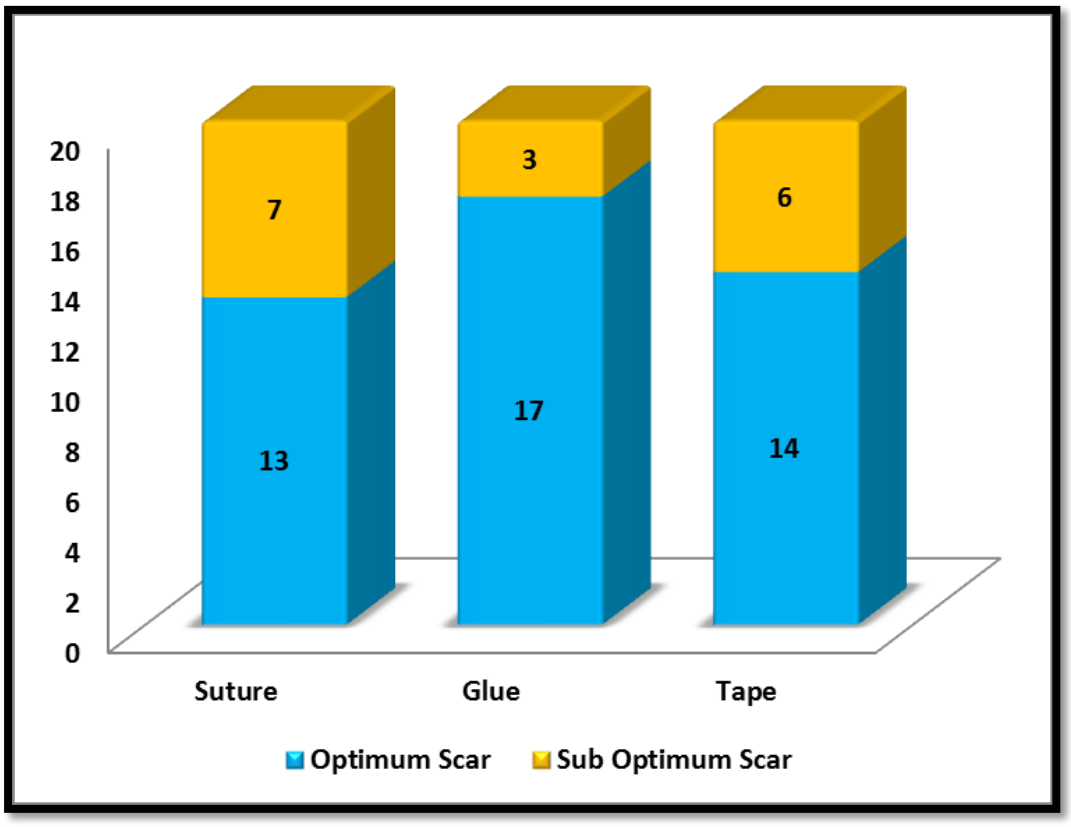
	Optimum Scar	Sub Optimum Scar	Suture	Glue
Suture	**12**	**8**		
Glue	**15**	**5**	**P = 0.5006**	
Tape	**13**	**7**	**P = 1.0000**	**P = 0.73109**



Day 3

There was no significant difference in the Hollander wound evaluation score among the three groups on day 3.

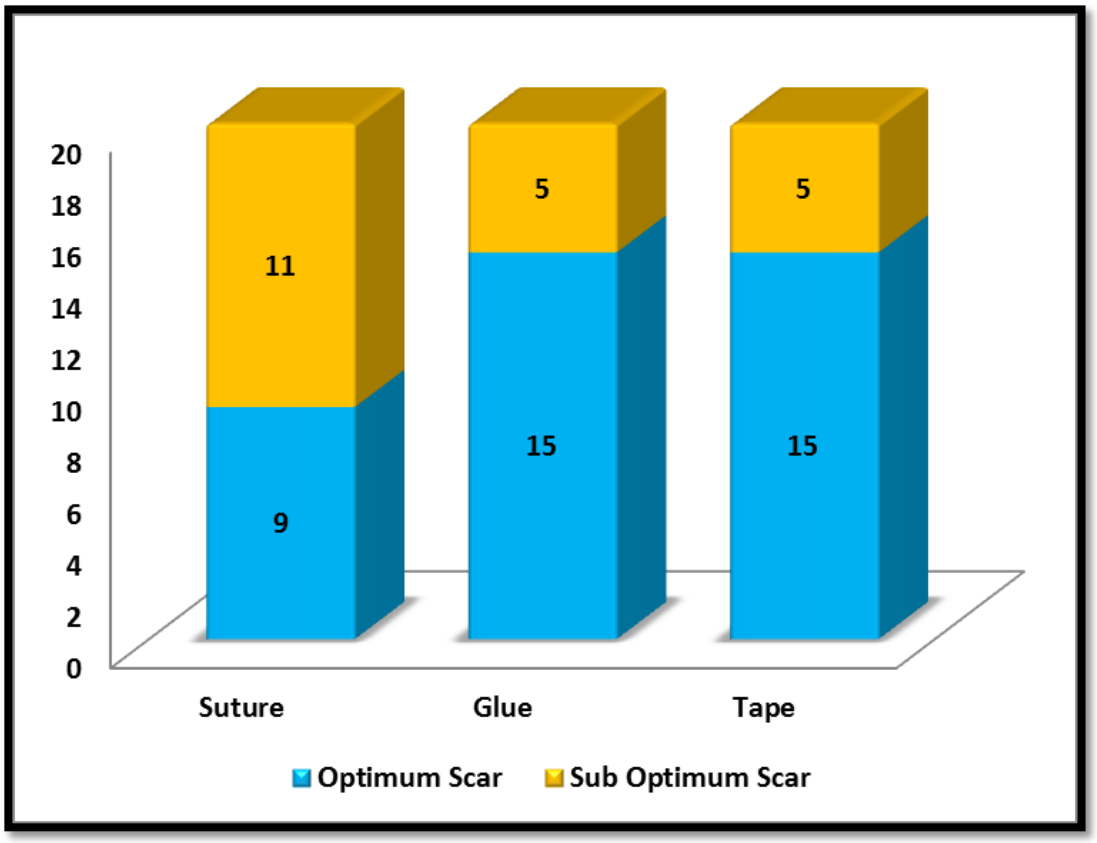
	Optimum Scar	Sub Optimum Scar	Suture	Glue
Suture	**13**	**7**		
Glue	**17**	**3**	**P = 0.2733**	
Tape	**14**	**6**	**P = 1.0000**	**P = 0.4505**



Day 7

There was no significant difference in the Hollander wound evaluation score among the three groups on day 7.

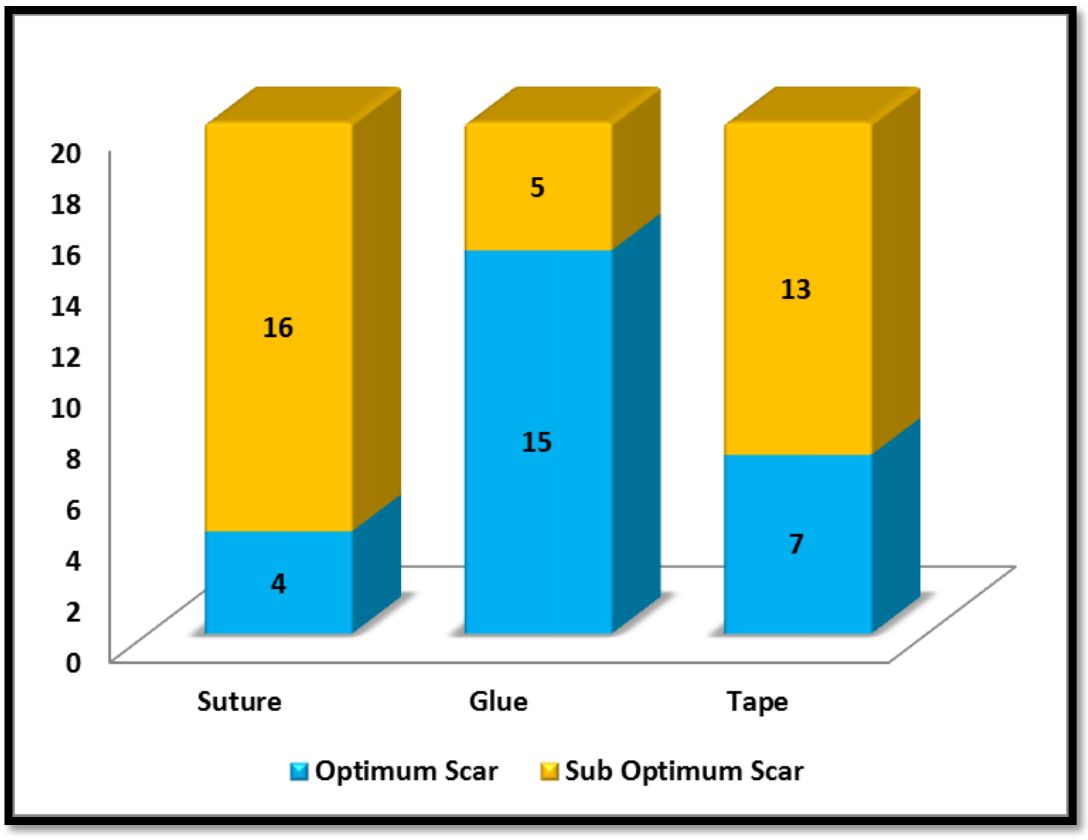
	Optimum Scar	Sub Optimum Scar	Suture	Glue
Suture	**9**	**11**		
Glue	**15**	**5**	**P = 0.1053**	
Tape	**15**	**5**	**P = 0.1053**	**P = 1.0000**



Day 30

There was significant difference in the Hollander wound evaluation score between adhesive glue and suture and between adhesive glue and tape. There was no significant difference between tape and suture on day 30.

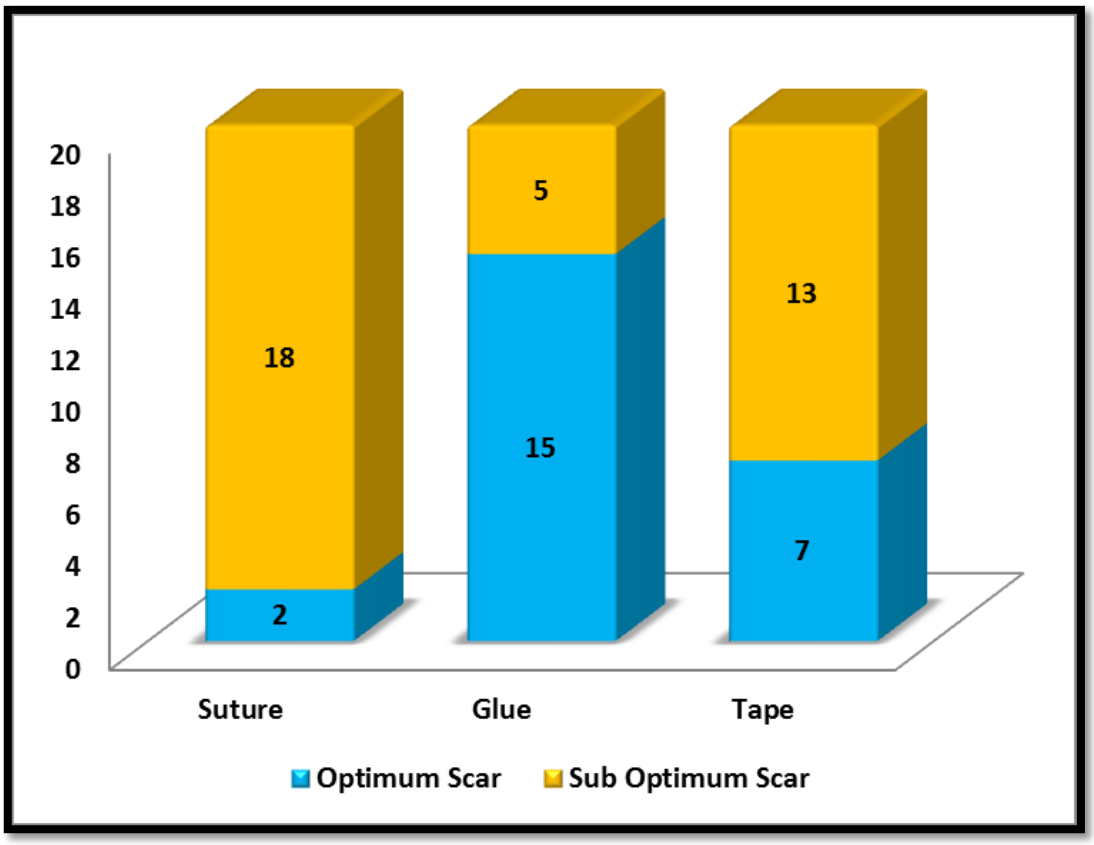
	Optimum Scar	Sub Optimum Scar	Suture	Glue
Suture	**4**	**16**		
Glue	**15**	**5**	**P = 0.0012**	
Tape	**7**	**13**	**P = 0.4801**	**P = 0.0248**



Day 90

There was significant difference in the Hollander wound evaluation score among the three groups on day 90.

	Optimum Scar	Sub Optimum Scar	Suture	Glue
Suture	**2**	**18**		
Glue	**15**	**5**	**P < 0.0001**	
Tape	**7**	**13**	**P = 0.0012**	**P = 0.0248**

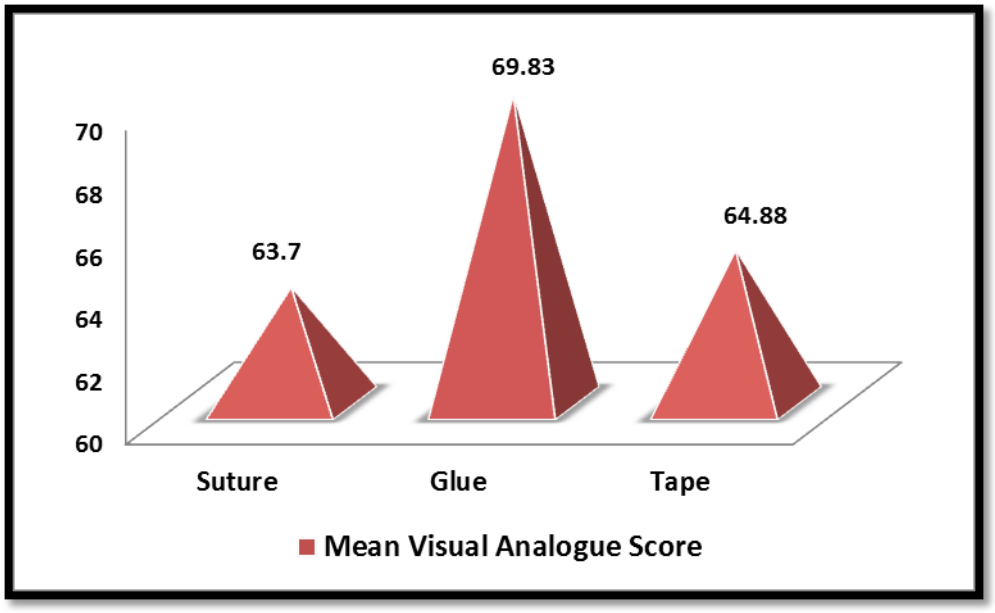


5.2.5.2.The Visual Analogue Score

Day 1

There was no significant difference in the visual analogue scale among the three groups on day 1.

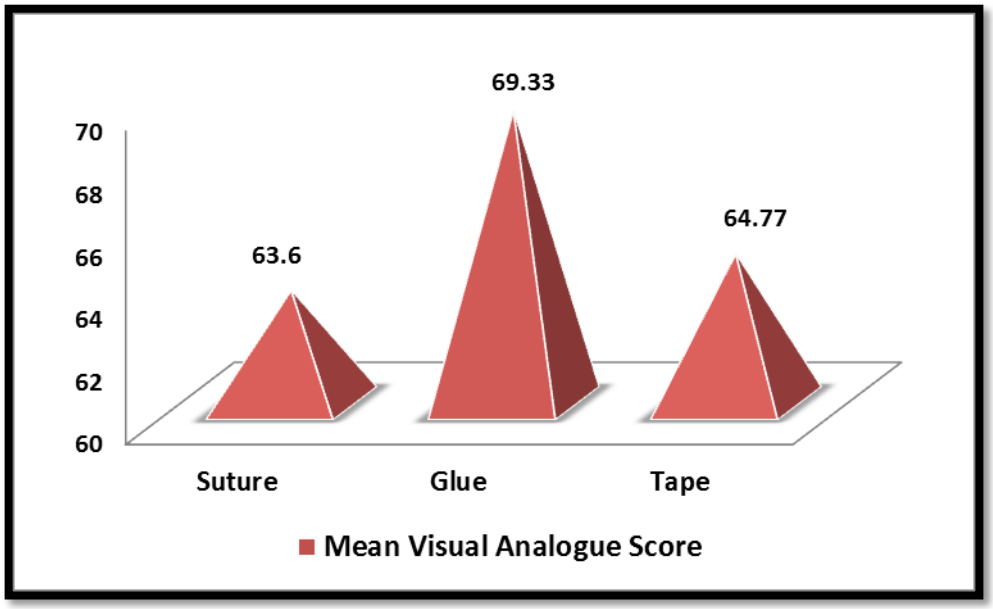
	Mean Visual Analogue Score
Suture	**63.7**
Glue	**69.83**
Tape	**64.88**
P > 0.05 = No significant difference	



Day 2

There was significant difference in the visual analogue scale on comparison of glue with suture and tape on day 2.

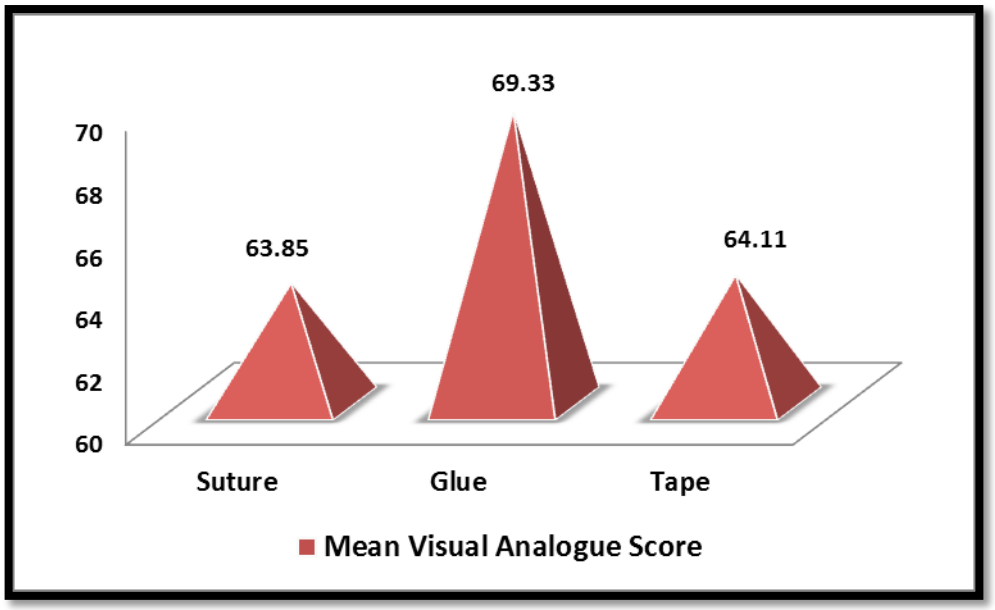
	Mean Visual Analogue Score
Suture	**63.6**
Glue	**69.33**
Tape	**64.77**
P < 0.0001 Glue vs Suture, Tape	



Day 3

There was significant difference in the visual analogue scale on comparison of glue with suture and tape on day 3.

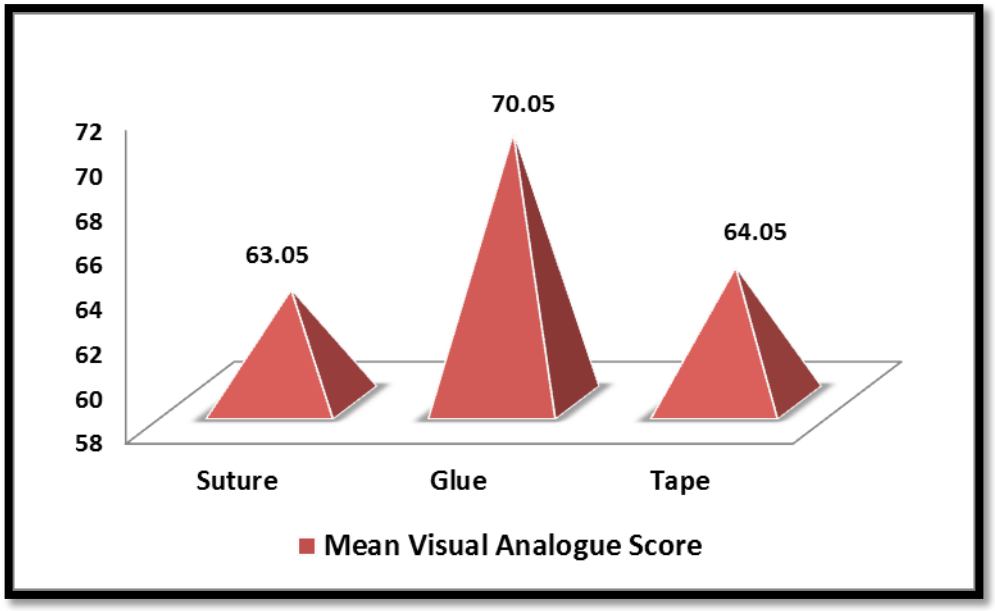
	Mean Visual Analogue Score
Suture	**63.85**
Glue	**69.33**
Tape	**64.11**
P < 0.0001 Glue vs Suture, Tape	



Day 7

There was significant difference in the visual analogue scale on comparison of glue with suture and tape on day 7.

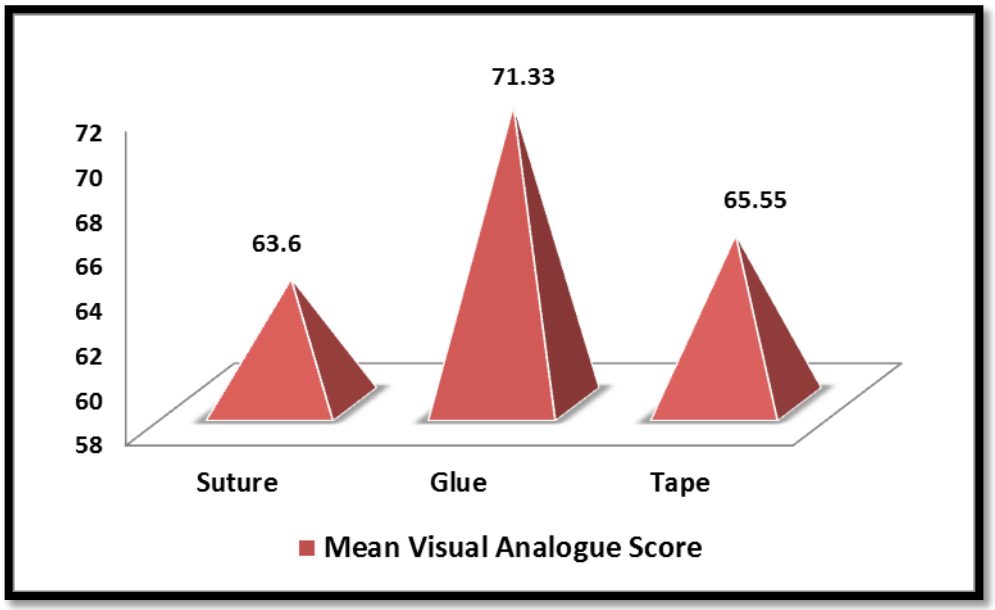
	Mean Visual Analogue Score
Suture	**63.05**
Glue	**70.05**
Tape	**64.05**
P < 0.0001 Glue vs Suture, Tape	



Day 30

There was significant difference in visual analogue score among the three groups on day 30.

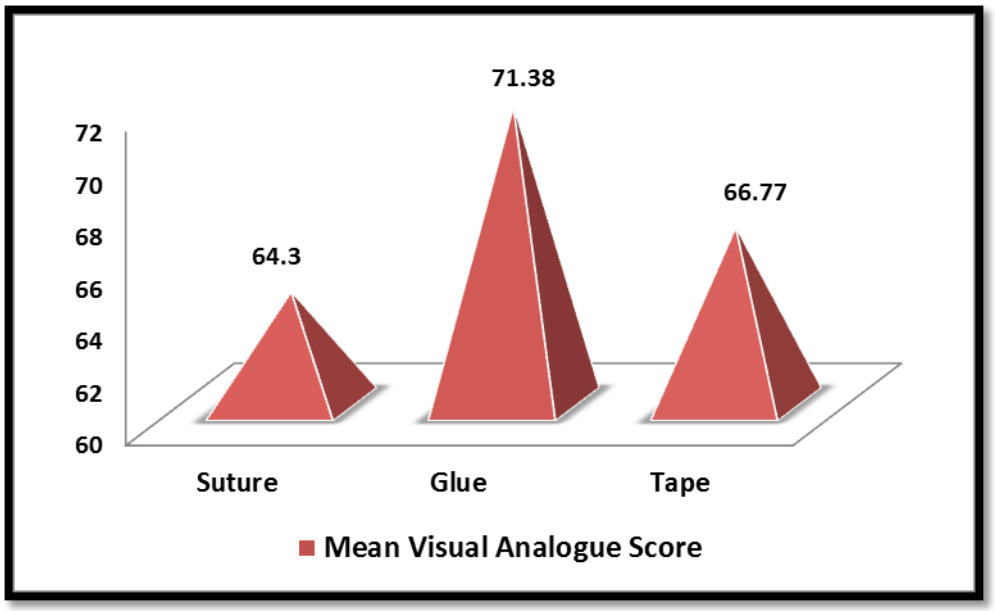
	Mean Visual Analogue Score
Suture	**63.6**
Glue	**71.33**
Tape	**65.55**
P < 0.0001 Suture vs Glue vs Tape	



Day 90

There was significant difference in visual analogue score among the three groups on day 90.

	Mean Visual Analogue Score
Suture	**64.30**
Glue	**71.38**
Tape	**66.77**
P < 0.0001 Glue vsSuturevs Tape	

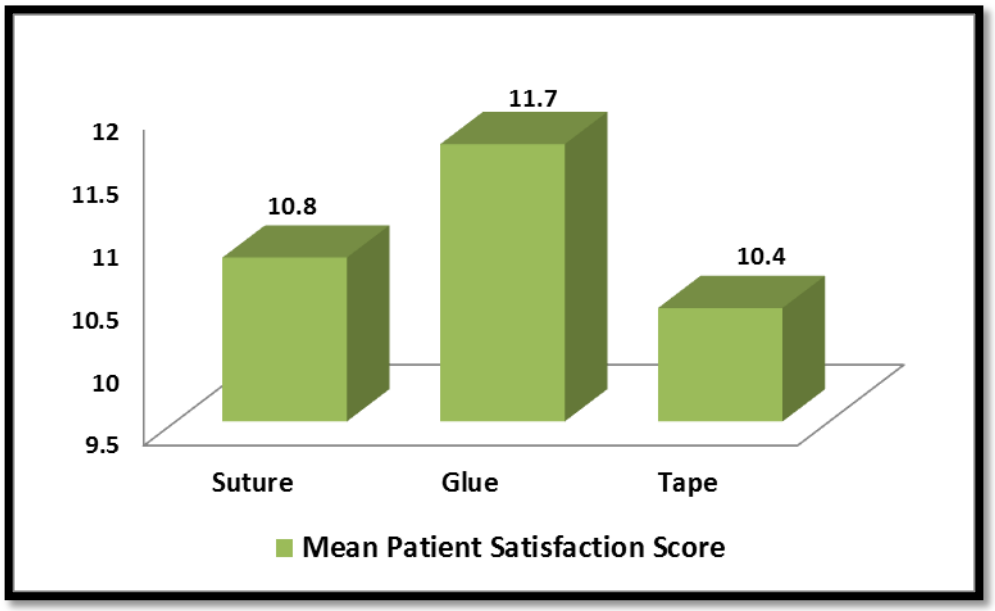


5.2.6. PATIENT SATISFACTION

Day 7

There was no significant difference in patient satisfaction between the three groups on the day 7.

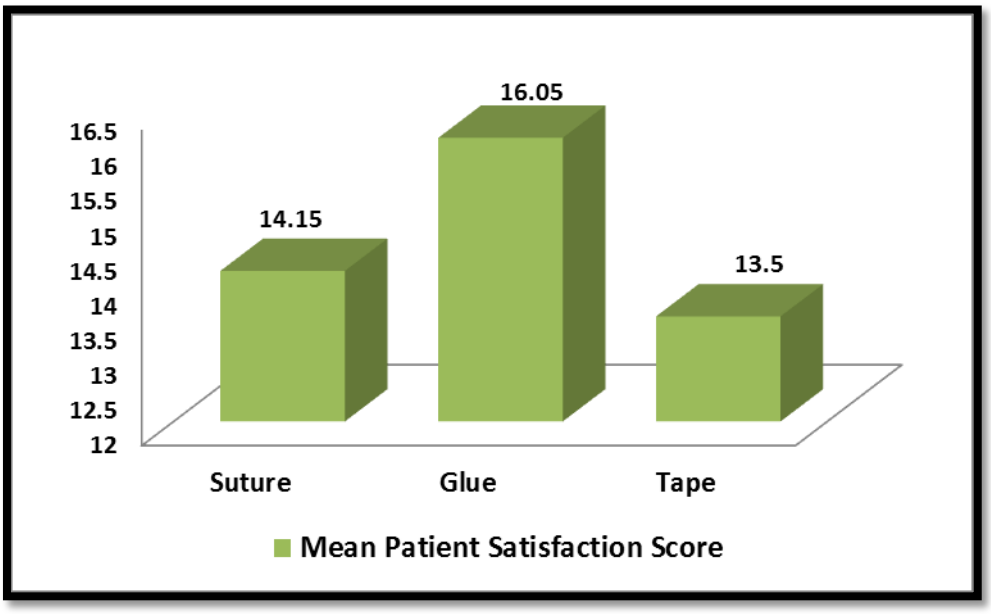
	Mean Patient Satisfaction Score
Suture	**10.8**
Glue	**11.7**
Tape	**10.4**
P = 0.6422 = No significant difference	



Day 30

There was significant difference in patient satisfaction when comparing glue with suture and tape. There was no significant difference between tape and suture on day 30.

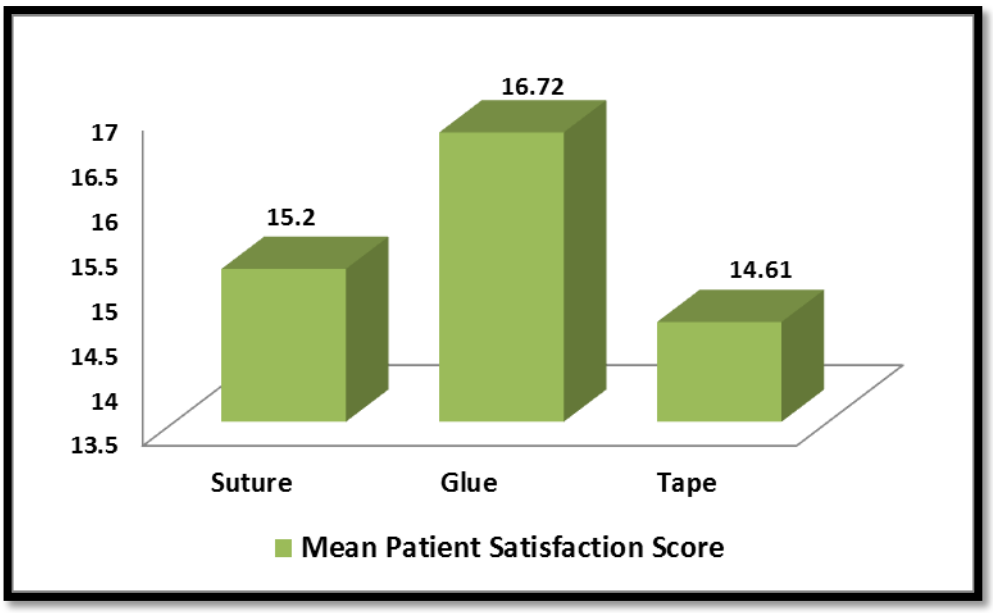
	Mean Patient Satisfaction Score
Suture	**14.15**
Glue	**16.05**
Tape	**13.5**
P < 0.0001 Glue vs Suture, Tape	



Day 90

There was significant difference in patient satisfaction when comparing glue with suture and tape. There was no significant difference between tape and suture on day 90.

	Mean Patient Satisfaction Score
Suture	**15.2**
Glue	**16.72**
Tape	**14.61**
P < 0.0001 Glue vs Suture, Tape	

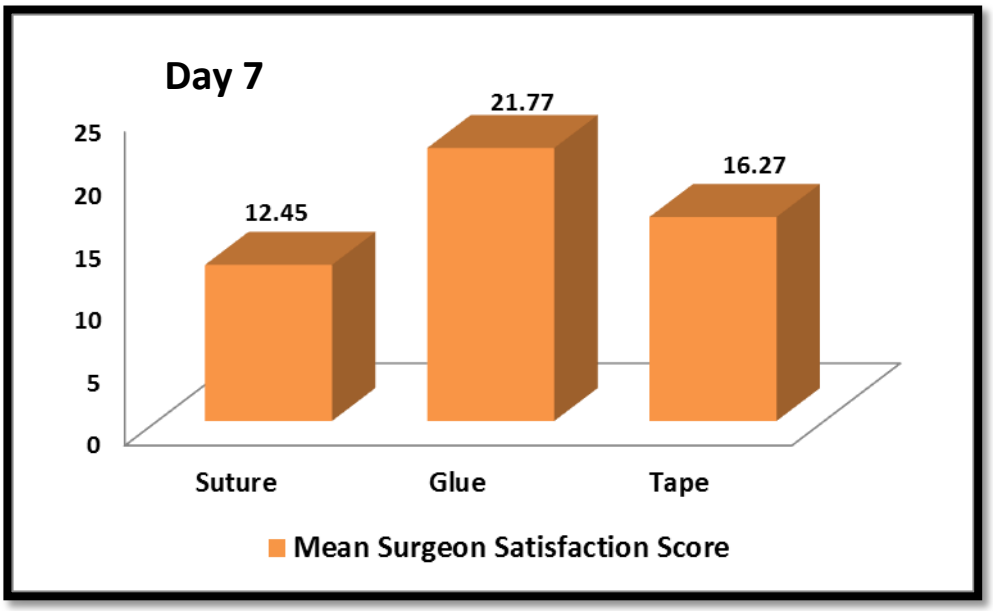


5.2.7. SURGEON SATISFACTION

Day 7

There was significant difference in surgeon satisfaction between the three groups on the day 7.

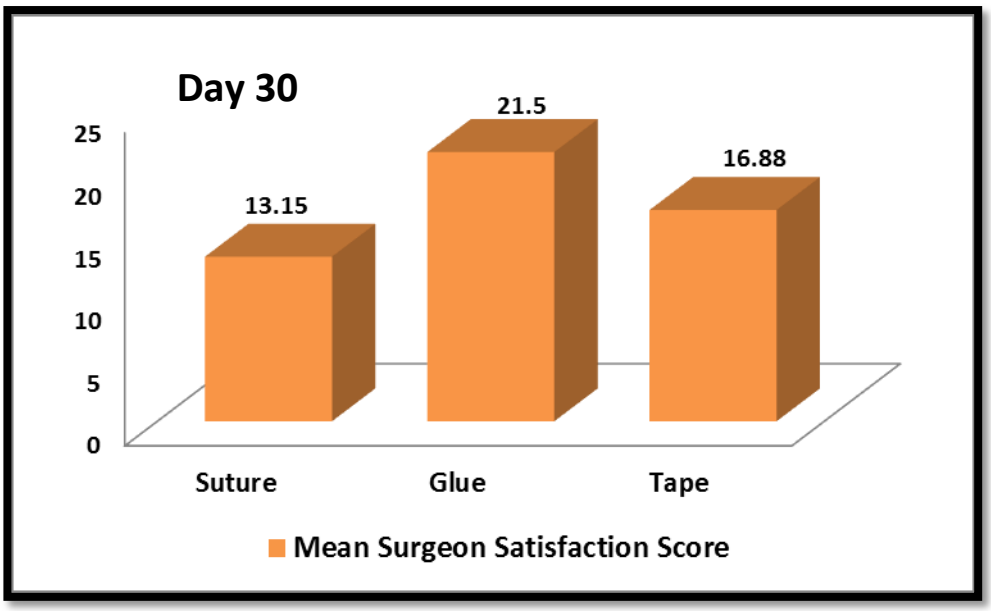
	Mean Surgeon Satisfaction Score
Suture	**12.45**
Glue	**21.77**
Tape	**16.27**
P < 0.0001 Suture vs Glue vs Tape	



Day 30

There was significant difference in surgeon satisfaction between the three groups on the day 30.

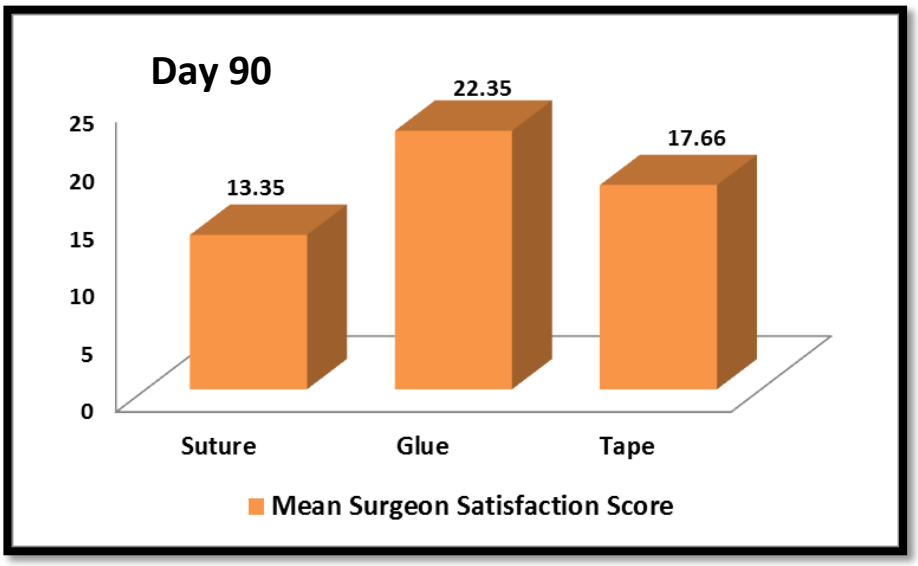
	Mean Surgeon Satisfaction Score
Suture	**13.15**
Glue	**21.5**
Tape	**16.88**
P < 0.0001 Suture vs Glue vs Tape	



Day 90

There was significant difference in surgeon satisfaction between the three groups on the day 90.

	Mean Surgeon Satisfaction Score
Suture	**13.35**
Glue	**22.35**
Tape	**17.66**
P < 0.0001 Suture vs Glue vs Tape	



DISCUSSION

6. DISCUSSION

6.2.1. WOUND DEHISCENCE

Wound dehiscence is one of the most important parameter that is used to assess the effectiveness of different wound closure techniques(21). An effective system is the one which prevents wound dehiscence at all stages of wound healing, more importantly during the early stages. Since sutures are tied secured by knots, dehiscence is uncommon unless the wound gets infected. The reason for wound dehiscence in the patient with adhesive glue in this study could be attributed to the excessive stretch of the skin at the incision site during mobilization or improper technique of glue application by the surgeon. The dehiscence occurred during the early stages of the study and after usage of proper technique during closure and by preventing of excessive movement by the patients, the dehiscence rates significantly reduced and no wound dehiscence occurred further.

6.2.2. WOUND INFECTION

Infection of the post-operative wound is a common problem and it significantly impacts the patient and health care providers.(22).Many surgical procedures are being done in out-patient setup which prevent monitoring the wound for infections by the health care provider. Though

this study did not report any wound infection, earlier studies show various infection rates, 11 percent in Maartense study (19) and 8.5 percent in Malonestudy(20)

Tissue adhesive glue might act as a protective barrier for the wound and may prevent wound infection by preventing the entry of microorganisms. However earlier studies have not shown a significant decrease in the infection rates following use of adhesive glue(20).

6.2.3. EFFICIENCY

Time is an important factor in the operating room. (23)New innovations in surgery have made the operating procedure efficient by decreasing the time required for the procedure. For example, the advent of gut staplers has significantly reduced the time required for bowel anastomosis when compared to conventional sutures.(24). Similar advances have been made in the wound closure techniques. The time for closure was least for adhesive tapes and was significantly lesser when compared to adhesive glue and sutures. However there was no significance difference in the time taken for the adhesive glue and suture. The most important factor that influenced glue application was achievement hemostasis in the skin edges. Adhesive glue required proper hemostasis before application. An earlier

study showed similar results where tape was the fastest method for closure followed by adhesive glue followed by suture.(18)

6.2.4. COST

Another important factor in any operation is the cost involved(25). Higher costs of operation are a burden for the patient and health care providers. But sometimes newer innovations and techniques, which are more effective, involve more cost than the conventional techniques until it is being used widely in mass scale. In this study adhesive tapes cost three times lesser than the suture and eight times lesser than glue. Though adhesive tapes are significantly cheaper than glue and suture, it was noted that the tapes got soaked postoperatively due to discharge from the wound and required replacement throughout the post-operative period up to day seven. This can add up the total cost for the wound care and may raise the costs for closure. Though glue is the most expensive method among the three, other factors like reduced usage of wound dressing, non-requirement of revisit for suture removal make glue a cheaper option. Also the cost difference is negligible when compared to the total cost of the operation. (26)

6.2.5. COSMETIC APPEARANCE

The best scar is the absence of scar itself. The surgical site scar is something that remains in the patient for the rest of the life following the operation. Hence, medical researchers are continuously striving for a scar less wound closure technique. Though sutures have been in use for centuries from now, there is only a little improvement in the post operative suture mark. Use of silk in the past for skin closure resulted in ugly suture marks since it is multifilament and not inert as compared to the monofilament sutures. Monofilament sutures have reduced the severity of suture marks. Adhesive glue and tapes have the advantage of having no suture marks post operatively. The cosmetic appearance was assessed using the Modified Hollander Scar evaluation score (27) and Visual analogue scale for scar on post-operative day 1,2,3,7,30 and 90. There was no significant difference in the cosmetic appearance by Hollander scar evaluation score on day 1,2,3 and 7 between all three groups. On post-operative day 30, adhesive glue appeared significantly better looking when compared with the suture. Cosmetic appearance at day 90 is a better indicator of appearance of scar after one year as compared to day 7 or 30(15, 28)This study showed a significant difference between all three methods with scar of adhesive glue looking best followed by adhesive tape

and the worst scar was from the suture. Similar results were obtained from the visual analogue scale on day 90. Adhesive glue scored significantly higher on the visual analogue score on day 2,3,7 and 30 over suture and adhesive tape. However there was no significant difference on day 1. Earlier studies showed similar results where adhesive glue had significantly better cosmetic scar compared to other methods(15).

6.2.6. PATIENT SATISFACTION

Surgical scar is one of the key factors that make many people are unwilling for open surgery and seek non-surgical alternatives. Hence patient satisfaction is an important tool to assess the quality of wound closure system. The patient satisfaction was assessed using a pre validated questionnaire(29) that was given to the patient on the day 7, 30 and 90 following surgery. Patients with bilateral hernia and with two different methods used in them were able to tell the difference better. There was no significant difference in patient satisfaction on the seventh postoperative day. But on day 30 and 90 post-operatively the patients were significantly satisfied with adhesive glue compared to suture and adhesive tape. This difference in satisfaction may be attributed to ability of patients to take bath earlier and no requirement for revisit in the adhesive glue.

6.2.7. SURGEON SATISFACTION

Every surgeon would prefer a wound closure technique that is simple to use, efficient, and without any risk of needle stick injury. The adhesives score over sutures in all these points.(30) This can be reflected in this study where there was significant difference in the satisfaction among the three groups with the adhesive glue having the maximum satisfaction score followed by the adhesive tape and the least being the sutures on postoperative day 7, 30 and 90.

CONCLUSION

7. CONCLUSION

Adhesive glue and tapes have a great potential in the near future for closure of surgical wounds. This study shows that adhesive glue is a better option for wound closure by having the following advantages over suture

- They have better cosmetic appearance than suture
- They have better patient acceptance than suture
- They have a high surgeon satisfaction rate than suture
- Unlike suture, revisit to the hospital is not necessary after glue application

However, use of adhesive glue is not without disadvantages. The cost of the glue is significantly more than the suture. The study shows that adhesive glue also carries a risk of wound dehiscence following excessive stretching. This can be avoided by proper technique and wound care.

Cost must not influence the choice of wound closure system. Better predictors are cosmesis, patient and surgeon satisfaction.

The study shows the importance of alternative methods of wound closure (31) and its positive potential in the future of managementof surgical wounds.

The limitations of study were,

- The study was conducted in small number of patients
- The study was limited to a single type of surgery
- The study was not conducted on high tension wounds
- The study was not conducted on emergency surgeries
- The patients with impaired wound healing were not included

SUMMARY

8. SUMMARY

Suture has been used for closure of wounds for centuries and still remains the most commonly used method. Recent focus is on the usage of adhesive glue for surgical incisions. There are only a few clinical trials that have been conducted to support this indication. Another method is the application of adhesive tape for wound closure. The tape is available very cheap as compared to glue and suture and has shown to be a fast and cheap alternative. There are very few studies that have compared the three methods for wound closure. The objectives of the present study are To compare the wound dehiscence rates of suture, N-Butyl-2-Cyanoacrylate glue and adhesive tape following wound closure, to compare the wound infection rates of the three closure methods, to compare the time taken for wound closure using the three techniques, to compare the costs incurred for wound closure in three methods, to compare the cosmetic appearance of the three wound closure methods, to compare the patient satisfaction in the three closure techniques and to compare the surgeon satisfaction in the three closure techniques. A total of 60 patients were randomized into three groups of 20 each. Among the 60 participants 55 were males and 5 were females. The mean age of patients in suture, glue and tape group was 50.5, 41.6 and 32.65 years respectively. The mean length of wound incision in

suture, glue and tape group was 6.37, 5.74, and 5.54 respectively. Wound dehiscence was noted in one patient in the glue group during the second post-operative day. The wound was closed by using 3-0 polypropylene suture using sterile precautions. There was no wound that got infected during the study period. The application of adhesive tape took significantly less time when compare to the suture and glue method (P = 0.0067). There was no significant difference in the time taken for application of suture and glue. The average cost of closure using Suture was Rs. 185, adhesive glue - Rs. 540 and adhesive tape – Rs 64. There is a significant difference in the cost involved for wound closure among the three groups (P<0.001). Adhesive glue and tapes have a great potential in the near future for closure of surgical wounds. This study shows that adhesive glue is a better option for wound closure by having better cosmetic appearance, better patient acceptance, high surgeon satisfaction rate than suture than suture and adhesive tape. However, use of adhesive glue is not without disadvantages. The cost of the glue is significantly more than the suture. The study shows that adhesive glue also carries a risk of wound dehiscence following excessive stretching. This can be avoided by proper technique and wound care. Cost must not influence the choice of wound closure system. Better predictors are cosmesis, patient and surgeon satisfaction.

The study shows the importance of alternative methods of wound closure and its positive potential in the future of management of surgical wounds.

BIBLIOGRAPHY

9. BIBLIOGRAPHY

1. Quinn J, Wells G, Sutcliffe T. A randomized trial comparing octylcyanoacrylate tissue adhesive and sutures in the management of lacerations. *JAMA* 1997;277(19):1527–30.
2. Dowson C, Gilliam A, Speake W, Lobo D, Beckingham. A prospective, randomised controlled trial comparing n-butyl cyanoacrylate tissue adhesive (Liquiband) with sutures for skin closure after laparoscopic general surgical procedures. Surgical Laparoscopy, Endoscopy and Percutaneous Techniques 2006;16(3):146-50.
3. Chen HH, Tsai WS, Yeh CY, Wang JY, Tang R. Prospective study comparing wounds closed with tape with sutured wounds in colorectal surgery. Arch. Surg 2001; 136:801-3
4. www.eMedicine.com Skin anatomy – Accessed August 2012
5. Young.B, Heath.J.W. Wheather's Functional Histology. 4th Edition. Churchil. Livingstone. (London). 2000.
6. Martin H.Kroll,MD, Louis J.Picker,MD, Robbin's Pathologic Basis of Diseases. 7th Edition. Elsevier (Pennsylvania): 2004.
7. Stuart Enoch, David John Leaper. Basic Science of Wound Healing. Surgery. 2005: 23:2:37-42.

8. www.eMedicine.com Wound healing– Accessed August 2012
9. David, L. Dunn, Wound Closure Manual. Ethicon. Johnson and Johnson (USA)
10. Coover HN, Joyner FB, Sheere NH. Chemistry and performance of cyanoacrylate adhesive. Journal of the Society of Plastic Surgery of England 1959;1:5–6.
11. Lee BB, Do YS, Yakes W, Kim DI, Mattassi R, Hyon WS (March 2004). "Management of arteriovenous malformations: a multidisciplinary approach". *J. Vasc. Surg.* 39 (3): 590–600
12. Lo GH, Lai KH, Cheng JS, Chen MH, Chiang HT (May 2001). "A prospective, randomized trial of butyl cyanoacrylate injection versus band ligation in the management of bleeding gastric varices". *Hepatology* 33 (5): 1060
13. Chen WC, Hou MC, Lin HC, Chang FY, Lee SD (February 2000). "An endoscopic injection with N-butyl-2-cyanoacrylate used for colonic variceal bleeding: a case report and review of the literature". *Am. J. Gastroenterol.* 95 (2): 540–2.
14. Coulthard P, Esposito M, Worthington HV, van der Elst M, van Waes OJF, Darcey J. Tissue adhesives for closure of surgical incisions.Cochrane Database of Systematic Reviews 2010, Issue 5

15. Hollander JE, Singer AJ, Valentine S, Henry MC. Wound registry:Development and validation. Annals Emergency Medicine 1995;25:675–85.

16. Quinn J, Wells G .An Assessment of Clinical Wound Evaluation Scales. Academic Emergency Med 1998;5: 583-86

17. Quinn J, Wells G, Sutcliffe T, Jarmuske M, Maw J, Stiell I, Johns P. Tissue adhesive versus suture wound repair at 1 year: randomized clinical trial correlating early, 3-month, and 1-year cosmetic outcome. Annals of Emergency Medicine 1998;32(6):645–9.

18. Blondeel P, Murphy J, Debrosse D, Nix, J, Puls LE, Theodore N, Coulthard P. Closure of long surgical incisions with a new formulation of 2-octylcyanoacrylate tissue adhesive versus commercially available methods. American Journal of Surgery 2004; 188:307–13.

19. Maartense S, Bemelman WA, Dunker MS, de Lint C, Pierik EGJM, Busch ORC, Gouma DJ. Randomised study of the effectiveness of closing laparoscopic trocar wounds with octylcyanoacrylate, adhesive papertape or poliglecaprone. British Journal of Surgery 2002;89:1370–5.

20. Malone DL, Genuit T, Tracy JK. Surgical Site Infections: reanalysis of risk factors. *Journal of Surgical Research* 2002;103:89–95

21. Sniezek P, Walling H, DeBloom III J, Messingham M, VanBeek M, Kreiter C, et al.Arandomised controlled trial of high-viscosity 2-octyl cyanoacrylate tissue adhesive versus sutures in repairing facial wounds following Mohs micrographic surgery. Dermatological Surgery 2007;33(8):966–71.

22. Swtizer E, Dinsmore R, North J. Subcuticular closure versus dermabond: A prospective randomised trial. The American Surgeon 2003;69:434–6

23. Ong C, Jacobsen A, Joseph V. Comparing wound closure using tissue glue versus subcuticular suture for paediatric surgical incisions: a prospective, randomised trial. Paediatric Surgery International 2002;18:553–5.

24. http://www.ispub.com/journal/the-internet-journal-of-surgery/volume-15-number-2/a-comparative-study-of-sutured-and-stapled-anastomosis-in-gastrointestinal-operations.html#sthash.0crDTizX Accessed September 2012.

25. Shamiyeh A, Schrenk P, Stelzer T, Wayand WU. Prospective randomised blind controlled trial comparing sutures, tape, and octylcyanoacrylate tissue adhesive for skin closure after phlebectomy. Dermatologic Surgery 2001;27(10):877–80.

26. Brown JK, Campbell BT, Drongowski RA, Alderman AK, Geiger JD, Teitelbaum DH, Quinn J, Coran AG, Hirschl RB. A prospective, randomized comparison of skin adhesive and subcuticular suture for closure of pediatric hernia incisions: cost and cosmetic considerations. Journal of Paediatric Surgery 2009;44 (7):1418–22.
27. Chibbaro S, Tacconi L. Use of skin glue versus traditional wound closure methods in brain surgery: A prospective, randomized, controlled study. Journal of Clinical Neuroscience 2009;16(4): 535–9.
28. Toriumi DM, O'Grady K, Desai D, Bagal AB. Use of octyl-2-cyanoacrylate for skin closure in facial plastic surgery. Plastic and Reconstructive Surgery 1998;102(6):2209–19.
29. Amin M, Glynn F, Timon C. Randomised trial of tissue adhesive vs staples in thyroidectomy integrating patient satisfaction and Manchester score. Otolaryngology - Head and Neck Surgery 2009; 140(5):703–8.
30. Sajid MS, Siddiqui MR, Khan MA, Baig MK. Meta-analysis of skin adhesives versus sutures in closure of laparoscopic port-site wounds. Surgical Endoscopy 2009;23(6):1191–7.
31. Osmond MH. Pediatric wound management: the role of tissue adhesives. Pediatric Emergency Care 1999;15(2):137–40.

APPENDIX

APPENDIX 1 -PROFORMA

Name: **Ingo:**

Age/Sex: **DOA :**

DOD :

Address **Contact number:**

Diagnosis

Associated medical illness:

- ☐ **Anaemia**
- ☐ **Jaundice**
- ☐ **Diabetes Mellitus**
- ☐ **Tuberculosis**
- ☐ **Steroids**
- ☐ **Connective tissue disorders**
- ☐ **Past history of Keloid/ Hypertrophic scar**
- ☐ **Drug allergies**
- ☐ **Previous surgeries**

  Description of scar:_____

- ☐ **Smoking history:**_____
- ☐ **Alcohol intake:** _____
- ☐ **Others:** _____

Investigations

Complete blood count	
Hemoglobin%	
Random blood sugar	
Blood urea	
S. Creatinine	
Liver Functions Tests	
Chest X-ray	
ECG	

Perioperative Antibiotics given:

Operative Procedure:

Emergency ☐ **Elective** ☐

Diagnosis:

Operation done:

Anesthesia given:

Incision description:

Size: **Site:** **Shape:**

Closure:

Material used	**Suture**	**Adhesive glue**	**Adhesive tape**
Quantity used			
Cost			

Start time: _____

End time: _____

Outcomes:

Outcomes	Day 1	Day 2	Day 3	Day 7	Day 30	Day 90
Wound Dehiscence						
Wound infection*						
Hollander wound evaluation score /6**						
Visual analogue score* 0- 100**						

***Wound infection :**

Infection was considered present if any of the following were observed:

Redness, swelling, purulent discharge, pain, increased skin temperature, fever or other systemic signs of infection.

**** Hollander wound evaluation score**

- **Step off borders** Edges not on the same plane
- **Coutour irregularities** (Wrinkled skin near the wound)
- **Wound margin separation >2mm** (Gap between the sides)
- **Excessive distortion** (Swelling or infection)
- **Edge inversion** (Wound Not properly everted)
- **Overall cosmetic evaluation** (Acceptable not Acceptable)

Total Score = /6

*****Visual Analogue Score: Best possible scar as 100**

Worst possible scar as 0

Day 7, 30, 90

Patient Satisfaction Score:

Cosmesis of wound	**Poor** **Satisfactory** **Excellent** **0 1 2 3 4 5 6 7 8 9 10**		
Ability to shower the same day	**Poor (0)**	**Satisfactory(1)**	**Excellent (2)**
Tension on wounds	**Significant (0)**	**Moderate (1)**	**Slight (2)**
Overall comfort	**Poor (0)**	**Satisfactory(1)**	**Excellent (2)**
Hygiene problems	**Yes(0)**	**No(1)**	
Allergic reactions	**Yes(0)**	**No(1)**	
Overall satisfaction	**Poor** **Satisfactory** **Excellent** **0 1 2 3 4 5 6 7 8 9 10**		

Total Score:_____

Surgeon Satisfaction Score:

Cosmesis of wound	**Poor** **Satisfactory** **Excellent** **0 1 2 3 4 5 6 7 8 9 10**		
Ease of use	**Poor (0)**	**Satisfactory(1)**	**Excellent (2)**
Safety	**Poor (0)**	**Satisfactory(1)**	**Excellent (2)**
Effectiveness	**Poor (0)**	**Satisfactory(1)**	**Excellent (2)**
Applicability to a wide range of incisions	**No(0)**	**Yes(1)**	
Allergic reactions	**Yes(0)**	**No(1)**	
Overall satisfaction	**Poor** **Satisfactory** **Excellent** **0 1 2 3 4 5 6 7 8 9 10**		

Total Score:_____

APPENDIX 2 - PATIENT INFORMATION MODULE

Comparison of Tissue Adhesives, Adhesive tapes and Sutures for Wound Closure: A Prospective Study

Investigator: **Dr. Abinaya R.C**, PGY2 – MS (Gen Surg)

Guide: **Prof. Dr.T.S. Jayashree,** Chief, Unit S6

You are being invited to be a subject in this study.

Before you participate in this study, I am giving you the following details about this trial, which includes the aims, methodology, intervention, possible side effects, if any and outcomes:

Only those patients who are admitted in surgery department for elective hernia surgery will be included in the study.A detailed clinical history will be taken following a standardized proforma. A detailed clinical examination will be made and relevant investigations, including basic and special investigations will be done to diagnose your disease.

No other irrelevant or no new investigations will be done on you. You will not be subjected to any new or any irrelevant treatment procedure.

There will absolutely be no risk, whatsoever, due to this study. But the inherent risks due to your disease per se, or the risks due to the relevant investigations done to diagnose your disease or the risks due to the recommended surgical technique, or the risks that may arise due to the complications thereof, do apply in all situations.

The results arising from this study will be analyzed and used for academic purposes. You will be given clear instructions at every step and you are free to ask/ clarify any doubts. Your identity will remain confidential. You are free to withdraw from this trial at any point of time, without any prior notice &/ or without any medical or legal implications.

I request you to volunteer for this study.

Thanking You,

Investigator's Sign

(Dr. Abinaya R.C)

Patient's Sign

Name:

APPENDIX 3 - INFORMED CONSENT

Comparison of Tissue Adhesives, Adhesive tapes and Sutures for Wound Closure: A Prospective Study

Investigator: **Dr. Abinaya R.C**, PGY2 – MS (Gen Surg)

Guide: **Prof. Dr.T.S.Jayashree,** Chief, Unit S6

Name: Age/ Sex: IP:

I herewith declare that I have been explained in a language fully understood by me regarding the purpose of this study, methodology, proposed intervention, plausible side effects, if any and sequelae.

I have been given an opportunity to discuss my doubts and I have received the appropriate explanation.

I understand that my participation in this study is completely voluntary and that I am free to withdraw from this study at anytime without any prior notice &/ or without having my medical or legal rights affected.

I permit the author and the research team full access to all my records at any point, even if I have withdrawn from the study. However my identity will not be revealed to any third party or publication.

I herewith permit the author and the research team to use the results and conclusions arising from this study for any academic purpose, including but not limited to dissertation/ thesis or publication or presentation in any level.

Therefore, in my full conscience, I give consent to be included in the study and to undergo any investigation or any intervention therein.

Patient's Sign Investigator's Sign

(Dr.Abinaya R.C)

APPENDIX 4 - MASTER CHART

Sno	Name	IP No	Age	Sex	DIAGNOSIS	Anesthesia	Incision				Time (s)	cost	Hollander wound evaluation score** /6						Visual analogue score*** 0- 100						Patient Satisfaction Score			Surgeon Satisfaction Sco		
							SITE	Compl	SIZE (cm)	Closure	sec	Rs	1	2	3	7	30	90	1	2	3	7	30	90	7	30	90	7	30	90
1	MARIASUNDARAM	35569	56	M	B/L HERNIA	SA	RIGHT		6.7	SUTURE	321	185	6	6	6	6	5	5	78	80	80	68	68	68	11	15	17	12	13	13
2	AARUMUGAM	33582	65	M	RIGHT D HERNIA	SA	RIGHT		6	GLUE	324	540	6	6	5	5	6	6	80	78	80	80	80	78	12	14	14	20	22	22
3	KRISHNAN	44410	45	M	RIGHT D HERNIA	SA	RIGHT		6.5	TAPE	244	60	5	5	5	5	6	5	60	60	60	60	65	65	12	13	14	17	18	17
4	RAJESH SINGH	35437	33	M	RIGHT I HERNIA	SA	RIGHT	Dehisence	5.5	GLUE	255	540	5	6	6	6	6	6	60	0	0	0	0	0	0	0	0	0	0	0
5	MUNUSAMY	42471	67	M	LEFT D HERNIA HYDROCELE	SA	LEFT		6.5	TAPE	234	60	5	5	5	5	6	5	65	65	65	70	70	65	11	14	16	17	17	16
6	SYED AHAMED	43142	78	M	RIGHT D HERNIA	SA	RIGHT		6.8	SUTURE	300	185	5	5	5	5	6	5	68	65	65	65	60	60	12	15	14	12	13	14
7	MUNUSAMY	41104	64	M	LEFT D HERNIA	SA	LEFT		6.5	GLUE	344	540	6	6	6	6	6	6	72	74	75	75	75	75	13	14	16	21	21	22
8	SEKAR	30998	45	M	RIGHT DI HERNIA	SA	RIGHT		6.7	TAPE	224	80	5	5	5	5	6	5	66	67	62	60	62	64	12	14	15	17	16	17
9	VENKATESAN	40328	58	M	RIGHT DI HERNIA	SA	RIGHT		6.5	SUTURE	325	185	5	5	5	5	5	5	60	62	63	60	65	65	11	15	15	12	13	13
10	SRINIVASAN	33820	47	M	LEFT I HERNIA	SA	LEFT		6.6	SUTURE	354	185	5	5	5	5	5	5	60	60	62	63	64	65	11	16	16	12	12	13
11	RAMAKRISHNAN	40415	55	M	RIGHT D HERNIA	SA	RIGHT		6.5	GLUE	314	540	5	6	6	6	6	6	78	76	78	76	78	78	11	15	17	20	21	22
12	SUBRAMANI	33967	58	M	RIGHT D HERNIA HYDROCELE		RIGHT		6.8	TAPE	325	50	5	5	5	5	6	5	68	68	64	60	65	65	12	14	18	16	17	18
13	MANIKANDAN	28097	13	M	RIGHT I HERNIA	SA	RIGHT		5.5	TAPE	303	60	5	5	6	5	6	5	68	66	64	67	68	70	13	13	14	17	17	18
14	RAMPRASAD	39821	53	M	LEFT DI HERNIA	SA	LEFT	Dehisence	6.6	GLUE	298	540	5	6	6	6	6	6	60	0	0	0	0	0	0	0	0	0	0	0
15	SUBRAMANI	32077	76	M	B/L HERNIA	SA	RIGHT		6.7	SUTURE	363	185	5	5	5	5	6	5	60	62	64	66	64	65	11	14	17	14	14	13
16	MOORTHY	27434	47	M	LEFT I HERNIA	SA	LEFT		6	SUTURE	352	185	5	5	5	5	5	5	63	63	62	60	65	67	12	14	18	13	14	14
17	GANDHI	26688	47	M	RIGHT DI HERNIA	SA	RIGHT		6.5	TAPE	247	60	6	6	6	6	5	5	64	63	64	65	70	70	12	12	15	17	17	18
18	MUNUSAMY	39486	69	M	LEFT I HERNIA	SA	LEFT		6.7	GLUE	296	540	6	6	6	5	6	6	68	68	66	68	68	70	12	16	14	22	22	22
19	RAMESH	24099	58	M	B/L HERNIA	SA	RIGHT		6	TAPE	298	60	6	6	6	6	5	5	64	63	62	64	65	66	11	14	13	17	16	17
20	THIRUVENGADAM	25931	65	M	RIGHT D HERNIA	SA	RIGHT		6.8	SUTURE	376	185	5	5	5	5	5	5	64	62	60	60	63	63	13	15	12	12	13	13
21	AYAVU	39495	60	M	RIGHT D HERNIA	SA	RIGHT		7	GLUE	368	540	6	5	6	5	6	6	70	68	66	66	68	70	11	16	16	21	22	22
22	ANANDHARAJ	39991	32	M	LEFT I HERNIA	SA	LEFT		6.5	SUTURE	300	185	5	5	6	5	5	5	62	62	63	64	65	66	12	14	15	12	13	13
23	SHARMILA	76143	3	F	R CONG HERNIA	GA	RIGHT		3.2	GLUE	156	540	6	5	6	5	5	6	72	70	70	72	72	70	11	17	16	22	21	22
24	NIRMALA	75819	2	M	R CONG HERNIA	GA	RIGHT		3	TAPE	186	60	6	6	6	6	5	6	65	65	66	65	64	65	11	11	17	17	17	18
25	SANTHOSH	76149	50	M	RIGHT DI HERNIA	SA	RIGHT		6.8	GLUE	308	540	6	6	6	6	5	6	68	66	66	70	72	70	13	16	14	22	21	22
26	KUMAR	40338	23	M	LEFT I HERNIA	SA	LEFT		5	SUTURE	318	185	5	5	5	5	5	6	64	63	62	60	60	60	10	11	15	12	13	13
27	ANTONYRAJ	76193	4	M	L CONG HERNIA	SA	LEFT		3.4	TAPE	203	60	6	6	6	6	5	6	64	65	65	64	66	66	11	13	16	16	17	18
28	KRISHNAN	45212	32	M	RIGHT D HERNIA	SA	RIGHT		5.5	SUTURE	234	185	6	6	6	6	5	5	60	60	62	62	63	64	9	14	17	12	13	13
29	MAHALAKSHMI	76141	2	F	B/L CONG HERNIA	GA	RIGHT	Allergy	3	TAPE	134	60	6	5	5	6	5	5	60	0	0	0	0	0	0	0	0	0	0	0
30	SURESH	39498	23	M	LEFT I HERNIA	SA	LEFT		5.5	GLUE	198	540	6	6	5	6	5	5	65	66	68	68	70	70	14	17	18	22	21	22

Sno	Name	IP No	Age	Sex	DIAGNOSIS	Anesthesia	Incision				Time (s)	cost	Hollander wound evaluation score** /6						Visual analogue score*** 0- 100						Patient Satisfaction Score			Surgeon Satisfaction Score		
							SITE	Compl	SIZE (cm)	Closure	sec	Rs	1	2	3	7	30	90	1	2	3	7	30	90	7	30	90	7	30	90
31	SENDHIL	36496	34	M	LEFT I HERNIA	SA	LEFT		6.2	SUTURE	306	185	6	6	6	6	5	5	64	63	64	64	65	65	15	15	15	13	13	14
32	ARUL KUMAR	42562	20	M	RIGHT I HERNIA	SA	RIGHT		6.3	TAPE	253	60	6	6	6	6	5	6	66	65	64	63	65	65	12	16	14	15	17	18
33	BASKAR	39450	56	M	RIGHT DI HERNIA	SA	RIGHT		7.2	GLUE	376	540	6	5	6	6	6	6	68	68	66	70	72	72	12	17	15	22	21	22
34	RAFICK	76156	4	M	L CONG HERNIA	GA	LEFT		3.5	GLUE	185	540	6	5	6	6	6	6	66	68	66	70	72	72	11	13	16	22	22	23
35	RAMASAMY	38456	66	M	B/L HERNIA	SA	LEFT		7.7	TAPE	372	80	6	6	6	6	5	6	65	64	65	66	66	70	10	12	17	17	17	18
36	DINESH	36662	23	M	LEFT I HERNIA	SA	RIGHT		5.4	SUTURE	256	185	6	6	6	6	6	5	60	62	63	64	65	65	13	11	15	13	12	12
37	GNANAM	43451	70	M	B/L HERNIA	SA	LEFT		7.2	GLUE	306	540	6	5	6	6	6	6	70	68	68	70	73	72	11	17	17	21	21	22
38	PRASANNA	76199	7	M	R CONG HERNIA	GA	RIGHT		4.4	SUTURE	196	185	6	6	6	6	5	6	65	65	63	62	60	65	11	14	15	13	13	13
39	RAMESH	24099	58	M	B/L HERNIA	SA	LEFT		6	TAPE	207	60	6	6	6	6	5	6	64	64	65	63	64	65	12	15	14	16	17	18
40	SNEHA	75699	3	F	R CONG HERNIA	GA	RIGHT		2.8	GLUE	145	540	6	6	5	6	5	5	68	66	66	68	70	70	13	15	18	22	22	22
41	MARIASUNDARAM	35569	56	M	B/L HERNIA	SA	LEFT		6.7	SUTURE	300	185	6	6	6	6	6	5	65	63	62	63	64	65	14	13	17	12	12	13
42	MAHALAKSHMI	76141	2	F	B/L CONG HERNIA	GA	LEFT	Allergy	2.8	TAPE	125	55	6	5	5	6	5	5	60	0	0	0	0	0	0	0	0	0	0	0
43	HARIHARAN	38339	56	M	R DI HERNIA	SA	RIGHT		6.2	SUTURE	207	185	6	6	6	5	5	5	64	63	63	62	60	60	11	14	16	12	13	13
44	VINODH	32808	25	M	RIGHT I HERNIA	SA	RIGHT		5.8	GLUE	255	540	6	6	6	6	6	6	66	66	66	66	68	70	12	16	16	22	21	22
45	SRINIVASAN	76200	11	M	L CONG HERNIA	GA	LEFT		4.8	TAPE	209	55	6	6	6	6	6	6	66	66	64	64	66	65	10	16	15	15	17	18
46	INBARASU	39907	34	M	RIGHT I HERNIA	SA	RIGHT		5.6	GLUE	238	540	6	6	6	6	5	5	66	65	66	68	70	68	11	19	18	23	21	22
47	MUTHAIYAH	42563	62	M	RIGHT DI HERNIA	SA	RIGHT		7	TAPE	203	80	6	6	6	6	5	5	65	65	64	63	65	65	12	14	12	16	17	18
48	SUBRAMANI	32077	76	M	B/L HERNIA	SA	LEFT		7.4	SUTURE	276	185	6	6	6	6	5	5	65	64	64	63	64	64	12	15	13	12	13	13
49	SUNDHAR	49982	54	M	B/L HERNIA	SA	RIGHT		6.8	SUTURE	256	185	6	6	6	5	5	5	64	65	66	66	65	65	11	16	15	12	13	13
50	JAMBULINGAM	33890	71	M	RIGHT DI HERNIA	SA	RIGHT		6.4	GLUE	258	540	6	6	6	6	6	5	70	70	68	68	68	70	13	15	15	22	21	22
51	KASINATHAN	47831	44	M	RIGHT I HERNIA	SA	RIGHT		6.3	TAPE	276	60	6	6	6	6	5	5	65	65	66	65	65	64	12	12	13	16	17	18
52	GNANAM	43451	70	M	B/L HERNIA	SA	RIGHT		7.4	SUTURE	268	185	6	6	6	5	5	5	63	62	62	63	64	64	11	14	14	12	14	13
53	TCHANAMOORTHY	76257	7	M	L CONG HERNIA	SA	LEFT		5	TAPE	153	60	6	6	6	6	5	5	64	65	65	66	65	72	11	15	15	15	16	17
54	NANDHU	27565	24	M	RIGHT I HERNIA	SA	RIGHT		5.8	GLUE	243	540	6	6	6	6	6	5	72	73	73	68	68	70	12	16	19	23	23	22
55	RAMASAMY	38456	68	M	B/L HERNIA	SA	RIGHT		7	GLUE	302	540	6	6	6	5	6	6	70	68	70	70	72	72	10	15	17	22	22	22
56	UNNAMALAI	34567	66	M	LEFT DI HERNIA	SA	LEFT		7.4	SUTURE	254	185	6	6	6	6	5	5	62	62	63	64	64	65	12	16	16	15	16	17
57	MANIKANDAN	76201	8	M	L CONG HERNIA	GA	LEFT		5.3	TAPE	165	80	6	6	6	6	5	5	65	65	64	65	65	70	13	15	15	16	17	18
58	NAZIR AHAMED	35578	34	M	RIGHT I HERNIA	SA	RIGHT		5.7	TAPE	176	80	6	6	6	6	6	6	64	65	65	63	64	70	11	13	14	16	17	18
59	SANDHIYA	76140	2	F	R CONG HERNIA	GA	RIGHT		3.2	GLUE	134	540	6	6	6	6	6	6	68	70	70	68	68	68	14	14	13	23	22	22
60	SUNDHAR	49982	54	M	B/L HERNIA	SA	LEFT		6.5	SUTURE	300	185	6	6	6	6	5	5	63	64	64	63	64	65	12	14	12	12	13	14